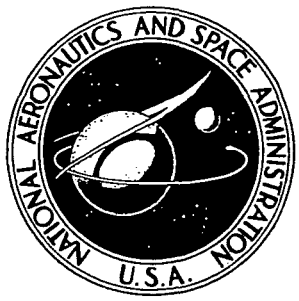
NASA TECHNICAL MEMORANDUM



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SPACE APPLICATIONS INSTRUMENTATION SYSTEMS

by R. A. Minzner and J. D. Oberholtzer

Electronics Research Center
Cambridge, Mass. 02139

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION • WASHINGTON, D. C. • MAY 1972

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16. Abstract

A Compendium of resumes of 158 instrument systems or experiments, of particular interest to space applications, is presented. Each resume exists in a standardized format, permitting entries for 26 administrative items and 39 scientific or engineering items. A Table of Contents shows that the resumes are organized into forty groups determined by the forty spacecraft with which the instruments are associated. The resumes are followed by six different cross indexes; each organized alphabetically according to one of the following catagories: Instrument Name, Acronym, Name of Principal Investigator, Name of Organization Employing the Principal Investigator, Assigned Experiment Number, and Spacecraft Name. The resumes are associated with a computerized Instrument Resume Search and Retrieval System (IRSARS).

17. Key Words (Suggested by Author(s))	18. Distribution Statement
Instrument Systems Resumes Standardized Format Administrative, Scientific, and Engineering Items (IRSARS)	Unclassified-Unlimited

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price*
Unclassified	Unclassified	281	$3.00

*For sale by the National Technical Information Service, Springfield, Virginia 22151

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CONTENTS (Continued)

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contents(Continued)

SPACE APPLICATIONS INSTRUMENTATION SYSTEMS

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SUMMARY

A compendium of resumes of 158 instrument systems or experiments, of particular interest to space applications, is presented. Each resume exists in a standardized format, permitting entries for 26 administrative items and 39 scientific or engineering items. A Table of Contents shows that resumes are organized into forty groups determined by the forty spacecraft with which the instruments are associated. The resumes are followed by six different cross indexes; each organized alphabetically according to one of the following catagories: Instrument Name, Acronym, Name of Principal Investigator, Name of Organization Employing the Principal Investigator, Assigned Experiment Number, and Spacecraft Name. The resumes are associated with a computerized Instrument Resume Search and Retrieval System (IRSARS).

INTRODUCTION

This document presents an interim report on Project 160-44-02-28-25, the objective of which has been to maintain an up-to-date survey of instrument systems of particular interest in space applications, and primarily intended for unmanned spacecraft. The continuing objective has been realized to date by the preparation of this compendium of standardized resumes for 158 specific systems. The systems described range from instruments (or experiments) which have already flown in orbiting spacecraft, to proposals for development projects. Each principal investigator, except any associated with instruments in the GEOS and ERTS satellites, and any recently appointed, has had the opportunity of reviewing some version of all resumes in which he is named. The set of resumes is preceded by an extensive Table of Contents; the resumes are followed by six different indexes.

The set of resumes is divided into two major groups. The first group, Part I, contains resumes describing instruments (or experiments) which have been built and flown, or are being built and tested for specifically planned flights. This group includes the resumes of about 100 space applications instruments (or experiments) associated with approximately forty spacecraft. The group includes separate resumes for each of a number of nominally similar instruments in each of several spacecraft. Such apparent duplication is necessary because successive models of essentially the same

instrument for different spacecraft are rarely alike. (An example of an instrument that has several models is the Satellite Infrared Radiometer Spectrometer, SIRS, which is aboard Nimbus 3, and scheduled to fly on Nimbus D.)

The second major group, Part II, contains those resumes for instruments (or experiments) which have been proposed but which have not been scheduled for flight in specific spacecraft, and for which production funds were not or have not yet been granted. The application instruments and experiments which were originally proposed for the Apollo program are included in this group. In a few instances, for proprietary reasons, the principal investigator has not released for general publication a resume listed in the Table of Contents and Indexes. In these cases, the indexing information has been retained for completeness, but the resume has been deleted so that the distribution of this document need not be limited.

Each resume is printed as a single page, and is a photographically reduced version of an original which was printed by a computer output device onto a special form. The form allows for sixty-five printed entries (ref. 1), and represents a slight modification of an earlier form having sixty-eight printed entries (ref. 2). The information for each item in a resume, in accordance with its own specific format (ref. 2) had been entered into a computer input and storage system previously. A computer program named IRSARS (ref. 2 and 3) permits a search to be made within the stored information for those instruments having characteristics which comply with specific limits of conditions of any of thirty-seven of the entries. The selected resumes or part thereof may be printed by the computer output device. No provisions have been made in IRSARS for either computer storage or computer printout of the diagrams called for in Item 66. Suitable diagrams have been collected for some of these resumes, but no attempt has been made to include any figures in this edition of the compendium.

The Table of Contents preceding the two groups of resumes, and the six indexes which follow the resumes have some intrinsic interest. The Table of Contents shows that resumes have been organized into a number of sections named after the forty associated spacecraft; these section names serve as an alphabetical index of these spacecraft. (A separate spacecraft listing is given in Index 6.) The names of the associated instruments (or experiments) are arranged alphabetically under each section name. Entries for similar instruments are each found under the appropriate spacecraft-section name rather than being grouped together. Thus, for example, the Satellite Infrared Radiometer Spectrometer, SIRS, can be found listed under Nimbus 3 as well as under Nimbus D; the Filter Wedge Spectrometer (FWS) can be found listed under Nimbus D in the first group of resumes, as well as under Apollo

Applications in the proposal group. In addition to the instrument name, each entry of any section of the Table of Contents also includes an acronym (or an abbreviation for the instrument of experiment name), any experiment numbers assigned by NASA Headquarters, and the name of the principal investigator for that instrument (or experiment).

The six indexes following the resumes also have been prepared with auxiliary material.

The first index is basically an alphabetical listing of the instrument (or experiment) names of the entire set of resumes (in contrast to the Table of Contents where the alphabetical listing was within sections separated according to spacecraft). Otherwise this index has the same information as that contained in the Table of Contents.

The second index is an alphabetically-arranged list of the names of the principal investigators. Each entry of this index also contains the organizational affiliation of the principal investigator, the acronym, the name of the spacecraft to which the instrument is assigned and, finally, any Headquarters-assigned experiment number.

The third index is an alphabetically-arranged list of the acronyms for the instrument (or experiment) name. Each entry of this index also contains the name of the spacecraft with which the system is identified, any assigned experiment number, the name of the associated principal investigator and, finally, the name of the instrument (or experiment).

The fourth index is an alphabetically-arranged list of the names of organizations by which each of the respective principal investigators is employed. Each entry of this index also includes the name of the principal investigator, the acronym, and the name of the associated spacecraft.

The fifth index is organized alphabetically and numerically according to a Headquarters-assigned experiment number. For example, the designation E01 was given to the Limb Radiance Experiment proposal for the Nimbus E satellite, and S040 was assigned to the proposal for the Dielectric Tape Camera System for an Apollo Applications spacecraft. Since only a few instruments have been assigned these numbers, this is a relatively small index.

The sixth and final index is a simple alphabetical listing of spacecraft relevant to this document. The page number indicates the location of the beginning of the group of resumes describing the instrument systems associated with each of these spacecraft.

The information contained in this survey is believed to be accurate to January 1970. The future responsibility for the continuing work in this study will be assumed by: R. Drummond of Goddard Space Flight Center, Code 731, Greenbelt, Md., Telephone: 301/982-6731. Corrections and suggestions for improving the resumes should be sent to Mr. Drummond.

The authors wish to acknowledge the support of this work by Jules Lehmann in the Office of Space Science and Applications at NASA Headquarters, and would like to thank the staff at the IIT Research Institute who contributed to this volume, particularly, William Vest, Jerrold Miller, and Peter Bock.

REFERENCES

(1) Miller, S., and Katz, N.: Addendum to Instrument Resumes for Space Applications, Employing a Computerized Search and Retrieval System. Final Report on Contract NAS 12-666, IIT Research Institute, 1970.

(2) Bock, P., and Vest, W. L.: Instrument Resumes for Space Applications, Employing a Computerized Search and Retrieval System. Interim Report on Contract NAS 12-666, IIT Research Institute, 1969.

(3) Bock, P., and Vest, W. L.: Operating manual for IRSARS (Instrument Resume Search and Retrieval System). Interim Report on Contract NAS 12-666, IIT Research Institute 1969.

PART 1

APOLLO 9

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2 ACRONYM	3. EXP NO
MULTISPECTRAL TERRAIN-PHOTOGRAPHY EXPERIMENT	MTP	S065
(TITLE CONT.)	4. RESUME DATE	
	11/10/69	0003

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
LOWMAN, DR. P.D.	GODDARD SPACE FLT CENTER	301-982-5554
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
COLWELL, DR. R.N.	UNIV OF CALIF, BERKELEY	415-845-6000-X1351

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					POST FLIGHT

18. MONITOR	19. AGENCY	20. PCM OFFICE	21. TELEPHONE
TERWILLIGER, R.G.	NASA HDQTRS	OSSA/SRB	202-962-0574

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LAST TIME
MSC INHOUSE (HASSELBLAD)	HOUSTON, TEXAS	03/69	NA

26. INSTRUMENT TYPE

IMAGER, FOUR 70-MM MODEL 500-EL HASSELBLAD CAMERAS — UNC

28. APPLICATION	29. SPACECRAFT
ERSP	APOLLO 9

30. PURPOSE

PRIMARY-TO OBTAIN PHOTOGRAPHS, TAKEN SIMULTANEOUSLY, IN FOUR SPECIFIC PORTIONS OF THE VISIBLE AND NEAR (PHOTOGRAPHIC) INFRARED FOR EARTH RESOURCES APPLICATIONS.***SECONDARY-TO ASSIST IN DETERMINING THE OPTIMUM FILM-FILTER COMBINATIONS FOR THE EARTH RESOURCES PROGRAM.

31. PRINCIPLES OF OPERATION

THE EQUIPMENT USED CONSISTS OF FOUR HASSELBLAD, 70 MM CAMERAS, MODEL 500-EL. THE INDIVIDUAL CAMERAS ARE SIMILAR TO THE 500 C USED ON PREVIOUS MANNED MISSIONS, EXCEPT THAT THIS SET IS ELECTRICALLY DRIVEN. THE CAMERAS ARE INSTALLED IN A COMMON MOUNT AND SYNCHRONIZED FOR SIMULTANEOUS EXPOSURE. THE MOUNT IS INSTALLED IN THE COMMAND MODULE HATCH WINDOW DURING PHOTOGRAPHIC OPERATIONS AND THE SPACECRAFT WILL BE ORIENTED TO PROVIDE VERTICAL PHOTOGRAPHY. AN INTERVALOMETER IS USED TO OBTAIN SYSTEMATIC OVERLAPPING (STEREO) PHOTOGRAPHY. POWER IS SUPPLIED BY INTERNAL BATTERIES. EACH CAMERA HAS A STANDARD 80 MM FOCAL LENGTH, PLANAR LENS AND A SINGLE FILM MAGAZINE CONTAINING FROM 160 TO 200 FRAMES. THE FOLLOWING FILM/FILTER COMBINATIONS WERE USED: 1) INFRARED AEROGRAPHIC FILM WITH AN 89B FILTER, 0.7 TO 0.9 MICRON; 2) COLOR IR WITH A WRATTEN 15 FILTER, 0.7 TO 0.9 MICRON; 3) PANATOMIC-X WITH A 25A FILTER, 0.58 MICRON INTO THE IR REGION; AND 4) PANATOMIC-X WITH A 58 FILTER, 0.48 TO 0.62 MICRON; PHOTOGRAHIC COVERAGE OF THE SOUTHWEST U.S.A. WAS EMPHASIZED BECAUSE GROUND INFORMATION IS MORE AVAILABLE FOR THIS REGION THAN OTHER REGIONS.

32. PHENOMENA OBSERVED

REFLECTED SOLAR RADIATION FROM THE SURFACE OF THE EARTH

33. MEASUREMENT RANGE

VARIES WITH TYPE OF FILM USED

34. PRECISION AND ACCURACY

0.48 TO 0.9 MICRON

52.0 BY 52.0 DEG 300 NM BY 300 NM FROM 300 NM ALTITUDE

0.009 DEG 280 FEET FROM 300 NM ALTITUDE

5.0 DEG LOW CIRCULAR MEDIUM POSIGRADE

ORBITAL POSITION DATA IS DESIRED AT THE TIME OF EACH EXPOSURE

4 HASSELBLAD CAMERAS

28 LB 1.5 CU FT

NONE NONE NONE SENSITIVE

PRE- AND POSTFLIGHT ONLY MANNED RETURN AS PROGRAMMED

NO SPECIFIC REQUIREMENTS

NO GROUND SUPPORT REQUIRED, CAMERAS HAVE BEEN FLIGHT QUALIFIED

64. REFERENCES

1) EXPERIMENT IMPLEMENTATION PLAN FOR MULTISPECTRAL TERRAIN PHOTOGRAPHY (S065). NASA, SEPT 23, 1968.***2) NASA PRESS RELEASE NO:69-29, APOLLO 9. FEB 23, 1969.***3) VERNER, S.S.: OPTICAL IMAGERS FOR THE SMALL EARTH RESOURCES SATELLITE. IIT RESEARCH INSTITUTE, APRIL 1967.

66. HISTORICAL REMARKS

SIMILAR CAMERAS FLOWN ON OTHER MANNED FLIGHTS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
FLUXGATE MAGNETOMETER	FMAG	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0003

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
COLEMAN, DR. P.J.	UNIV OF CALIF AT L.A.	
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
	NAS5-9570			12/66	OPERATIONAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
BURKE, J.R.	NASA HDQTRS	OSSA/SCS	202-962-0581

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
MARSHALL LABORATORIES	TORRANCE, CALIFORNIA	12/66	NNA

26. INSTRUMENT TYPE (SEL.) (UNC.)

MAGNETOMETER, BIAXIAL CLOSED LOOP FLUXGATE — UNC

28. APPLICATION	29. SPACECRAFT
ATM-PHYS	ATS 1

30. PURPOSE

PRIMARY - TO MEASURE THE MAGNETIC FIELD SURROUNDING THE SPACECRAFT, BOTH PARALLEL AND PERPENDICULAR TO THE SPIN AXIS AND TO DETECT MAGNETO HYDRO DYNAMIC (MHD) WAVE PROPOGATION WITHIN THE MAGNETOSPHERE.

31. PRINCIPLES OF OPERATION

THIS INSTRUMENT IS SIMILAR TO THAT FLOWN ON OGO-E AND CONSISTS OF TWO CLOSED LOOP, HARMONIC FLUXGATE MAGNETOMETERS AND ASSOCIATED ELECTRONICS. THE AXES OF THE 2 MAGNETIC PROBES ARE 90 DEG TO EACH OTHER AND 45 DEG TO THE SPIN AXIS OF THE SPACECRAFT. EACH MAGNETOMETER OUTPUT IS A COMPOSITE VOLTAGE CONSISTING OF A DC VOLTAGE PROPORTIONAL TO THE AMBIENT FIELD PARALLEL TO THE SPIN AXIS AND A SINUSOIDAL VOLTAGE WITH PEAK AMPLITUDE PROPORTIONAL TO THE MAGNETIC FIELD PERPENDICULAR TO THE SPIN AXIS. BOTH OUTPUTS ARE FED INTO A DIFFERENTIAL AMPLIFIER AND A SUMMING AMPLIFIER. THE DIFFERENTIAL AMPLIFIER YIELDS A SINUSODIAL SIGNAL PROPORTIONAL TO THE SUM OF THE AMPLITUDES OF THE TWO INPUT SINUSOIDS. THE OUTPUT OF THE SUMMING AMPLIFIER IS PROPORTIONAL TO THE SUM OF THE 2 DC COMPONENTS. THE INSTRUMENT HAS A SENSITIVITY OF 0.05 V PER GAMMA WHERE GAMMA EQUALS 10 TO THE MINUS 5 GAUSS. THE DYNAMIC RANGE IS +-50, 100, OR 200 GAMMA. WITH THE USE OF AN OFFSET FIELD GENERATOR, THE TOTAL DYNAMIC RANGE IS INCREASED TO + 925 GAMMA AND - 675 GAMMA. THE INSTRUMENT ACCURACY IS +- 0.125 GAMMA WITH A NOISE LEVEL OF 0.1 GAMMA. THE BASIC MAGNETOMETER RESPONSE BANDWIDTH IS FROM DC TO 100 HZ. IT PRODUCES AN OUTPUT VOLTAGE OF 0 TO + 5.0 VDC.

32. PHENOMENA OBSERVED

MAGNETIC FIELD

33. MEASUREMENT RANGE

-125 TO +350 GAMMA PARALLEL AND -50 TO+50 GAMMA PERP TO S/C AXIS

34. PRECISION AND ACCURACY

SEE ITEM 31

35. SPECTRAL RANGE | 36. SPECTRAL RESOLUTION | 37. TIME CONSTANT

SEE ITEM 31

38. FIELD OF VIEW | 39. GROUND SWATH

NA | NA

40. ANGULAR RESOLUTION | 41. OUTPUT RESOLUTION

NA | NA

42. POINTING ACCURACY | 43. POINTING RATE | 44. ALTITUDE | 45. ORBIT TYPE

NA | SYNCH CIRCULAR EQUATORIAL POSIGRADE

46. SPECIAL REQUIREMENTS

SENSOR, ELECTRONICS

47. COMPONENTS

2 MAGNETOMETERS, DIFFERENTIAL AMPLIFIER, SUMMING AMPLIFIER

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
4 LB	0.2 CU FT	4 WATTS			

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
SENS				REMOTE MOUNTING ON BOOM

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
INFLIGHT COMMAND	REALTIME TELEMETRY	CONTINUOUSLY

62. TELEMETRY FUNCTIONS

63. ADVANTAGES AND LIMITATIONS

64. REFERENCES

1) BARRY, J.D. AND SNARE, R.C.: A FLUXGATE MAGNETOMETER FOR THE APPLICATIONS TECHNOLOGY SATELLITE, IEEE TRANSACTIONS ON NUCLEAR SCIENCE VOL. NS-13, NO. 6 DEC 1966 P 326-332.***2) TECHNICAL DATA REPORT FOR THE ATS PROGRAM, GSFC VOL 6, 1968.

65. HISTORICAL REMARKS

66. DISTRIBUTION

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE: MICROWAVE TRANSPONDER
2. ACRONYM: MTRAN
(TITLE CONT.)
4. RESUME DATE: 11/10/69 0004

6. PRINCIPAL INVESTIGATOR: DARCEY, R.J.
7. ORGANIZATION: GODDARD SPACE FLT CENTER
8. TELEPHONE: 301-982-4094
9. CO-INVESTIGATOR
10. ORGANIZATION
11. TELEPHONE

12. CONTRACT TYPE
13. CONTRACT NUMBER
14. LAUNCH VEHICLE NUMBER
15. LAUNCH DATE
16. TERM. DATE: 12/66
17. STATUS: OPERATIONAL

18. MONITOR: BURKE, J.R.
19. AGENCY: NASA HDQTRS
20. TELEPHONE: OSSA/SCS 202-962-0581
22. VENDOR: HUGHES AIRCRAFT CO
23. LOCATION: EL SEGUNDO, CALIFORNIA
24. FLIGHT DATE: 12/66
25. LEAD FLIGHT: NA
26. INSTRUMENT TYPE: TRANSPONDER, 6-GHZ (RECEIVE) 4-GHZ (TRANSMIT) SHF
27. STATUS: UNC

28. APPLICATION: COMM
29. SPACECRAFT: ATS 1

30. PURPOSE

PRIMARY- TO INVESTIGATE THE TRANSMISSION OF VOICE, TELEVISION, AND DIGITAL DATA USING SSB TRANSMITTER AND RECEIVER IN MULTIPLE ACCESS MODE AND A HIGH QUALITY FM SYSTEM FOR TELEVISION AND HIGH SPEED DATA RELAY.***SECONDARY- TO SHARE EFFICIENTLY THE SPACECRAFT TRANSMITTED SIGNAL INDEPENDENT OF THE NUMBER OF CHANNELS IN USE.

31. PRINCIPLES OF OPERATION

THIS INSTRUMENT IS SIMILAR TO THOSE USED ON ATS-2 AND ATS-3. RECEIVING AND TRANSMITTING ANTENNAS AND TRAVELING-WAVE-TUBE POWER AMPLIFIERS ARE USED IN CONJUNCTION WITH A DUAL-MODE COMMUNICATION TRANSPONDER TO PROVIDE A SYSTEM ELEMENT CAPABLE OF ACCEPTING AND HANDLING ANY TYPE OF COMMUNICATIONS TRAFFIC OR WIDEBAND COMMUNICATIONS. THE FREQUENCY TRANSLATION MODE IS DESIGNED PRIMARILY FOR TELEVISION OR OTHER WIDEBAND USAGE IN WHICH ONE GROUND TRANSMITTER UTILIZES THE COMPLETE CHANNEL. THE USABLE BANDWIDTH IS 25 MHZ. THE MULTIPLE ACCESS MODE IS DESIGNED TO PERMIT THE INTERCONNECTION OF A LARGE NUMBER OF GROUND STATIONS IN A HIGH CHANNEL CAPACITY FREQUENCY DIVISION MULTIPLEX SYSTEM. FREQUENCY DIVISION MULTIPLEXING OF THE VOICE CHANNELS WITH SSB IS USED FOR THE VARIOUS GROUND-TO-SPACECRAFT LINKS. THESE SIGNALS ARE CONVERTED INTO PHASE MODULATION OF A SINGLE CARRIER IN THE SPACECRAFT AND ARE RETRANSMITTED TO ALL STATIONS IN THIS FORM. EACH GROUND STATION SELECTS THE APPROPRIATE CHANNELS FROM THE RECOVERED BASEBAND CONTAINING ALL CHANNELS TO COMPLETE THE TWO-WAY INTERCONNECTIONS. THE ANTENNA USED IS AN ELECTRICALLY DESPUN PHASED ARRAY. THE EFFECTIVE RADIATED POWER IS 166 WATTS.

32. PHENOMENA OBSERVED

TRANSMISSIONS FROM ATS GROUND STATIONS AT 6 GHZ

33. MEASUREMENT RANGE

34. PRECISION AND ACCURACY

36. SPECTRAL RESOLUTION: 6.212 TO 6.301 GHZ
37. TIME CONSTANT: 25. MHZ
39. GROUND SWATH: 18.0 BY 23.0 DEG
40. RESOLUTION: LIMB-TO-LIMB 9100 NM FROM GEO-SYNCH ALT
43. POINTING RATE
44. ALTITUDE
45. INCLINATION: SYNCH CIRCULAR EQUATORIAL POSIGRADE

TRANSPONDER, ANTENNA

49. WEIGHT
50. AVERAGE POWER
51. STANDBY POWER
52. PEAK POWER
53. MTBF
56. NUCLEAR INTERFERENCE
57. THERMAL INTERFERENCE
58. SHIELDING: SOURC/SEN
59. CALIBRATION: SENSITIVE
60. DATA RECOVERY: NA
61. FREQUENCY OF OBSERVATION: REALTIME TELEMETRY; CONTINUOUS
62. TELEMETRY REQUIREMENTS: NA

64. REFERENCES

1) PROJECT DEVELOPMENT PLAN-ATS, GSFC, GREENBELT, MD. DEC.,1965.
2) NASA PRESS KIT, ATS-B, RELEASE NO.66-308, DEC. 1966.

65. HISTORICAL REMARKS

THIS INSTRUMENT IS SIMILAR TO THOSE FLOWN ON ATS-2 AND ATS-3.

63. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
SPIN-SCAN CLOUD-COVER CAMERA	SSCC	
(TITLE CONT.)	4. RESUME DATE	5. [illegible]
MONOCHROMATIC	11/10/69	0003

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
SUOMI, DR. V.E.	UNIVERSITY OF WISCONSIN	608-262-5938
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
PARENT, DR. R.J.	UNIVERSITY OF WISCONSIN	608-262-5939

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
	NAS5-9677				2/66 OPERATIONAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
BURKE, J.R.	NASA HDQTRS	OSSA/SCS	202-962-0581

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
SANTA BARBARA RES CTR	GOLETA, CALIFORNIA	12/66	NA

26. INSTRUMENT TYPE	27. [illegible]
IMAGER, TELESCOPE-PHOTOMULTIPLIER ONE-CHANNEL VISIBLE	UNC

28. APPLICATION	29. SPACECRAFT
MET	ATS 1

30. PURPOSE

PRIMARY-TO PROVIDE HIGH-RESOLUTION PICTURES OF THE WHOLE EARTH'S DISK BETWEEN 52 DEG N AND 52 DEG S ALTITUDE ON A CONTINUOUS BASIS TO PERMIT SURVEILLANCE OF SHORT DURATION WEATHER CHANGES.

31. PRINCIPLES OF OPERATION

THE ATS SPIN SCAN CAMERA UTILIZES A HIGH RESOLUTION CASSEGRAIN TELESCOPE HAVING A "PINHOLE" APERTURE FOLLOWED BY A PHOTO-MULTIPLIER TUBE. THE VIDEO RASTER IS GENERATED IN THE WEST-EAST DIRECTION BY THE SATELLITE SPIN, NOMINALLY 100 RPM, AND IN THE NORTH-SOUTH DIRECTION BY MECHANICAL TILTING OF THE TELESCOPE OPTICAL AXIS IN DISCRETE STEPS FROM +7.5 TO -7.5 DEG. THIS PROVIDES EARTH COVERAGE FROM 52 DEG N. TO 52 DEG S. LATITUDE AND FROM THE WEST LIMB TO THE EAST LIMB. THIS AREA IS COVERED BY 2000 HORIZONTAL (W TO E) TV LINES. THE TOTAL LINE SCAN PERIOD PER REVOLUTION IS 0.6 SEC. A TOTAL TIME OF 20 MIN IS REQUIRED TO SCAN 1 PICTURE AND 2 MIN TO RETRACE. A BACK-TO-BACK MODE IS ALSO POSSIBLE IN WHICH THE RETRACE IS AT THE SAME RATE AS THE FORWARD SCAN. THE SCAN MAY BE REVERSED AT ANY TIME ONLY IN THE BACK-TO-BACK MODE. A PARABOLIC PRIMARY QUARTZ MIRROR WITH A 5-IN DIAM AND A 10-INCH FL IS USED WITH A FLAT SECONDARY QUARTZ MIRROR TO PRODUCE AN IMAGE ON THE FACE OF AN APERTURE PLATE. THE .001-INCH DIAM APERTURE PROVIDES AN ANGULAR RESOLUTION OF 0.1 MILLIRADIAN. THE INSTANTANEOUS OPTICAL FOV IS 1.94 NM. THE SPACECRAFT SPIN AXIS IS NORMALLY ORIENTED PERPENDICULAR TO THE ORBIT PLANE OF THE S/C AND PARALLEL TO THE SPIN AXIS OF THE EARTH.

32. PHENOMENA OBSERVED

SUNLIGHT REFLECTED FROM THE EARTH'S SURFACE AND/OR CLOUDS

33. MEASUREMENT RANGE

DYNAMIC RANGE = 1000 FOR BRIGHTNESS RESOLUTION

34. PRECISION AND ACCURACY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.475 TO 0.630 MICRONS	NA	

38. FIELD OF VIEW	39. GROUND SWATH
15.0 BY 18.0 DEG	LIMB-TO-LIMB (7500 NM) FROM GEO-SYNCH ALT

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.007 DEG	2.5 NM AT CENTER

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		SYNCH CIRCULAR	EQUATORIAL POSIGRADE

46. SPECIAL REQUIREMENTS

OPERATES ONLY DURING DAYLIGHT; HIGHLY SENSITIVE TO SWEEP DISTORT

47. COMPONENTS

1-INCH PHOTOMULT TUBE, 5-INCH PARABOLOID, 2-INCH FLAT MIRROR

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
16 LB	0.45 CU FT		7 WATTS	24 WATTS	5 YRS

54. [illegible] INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
SENSITIVE				

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
	REALTIME TELEMETRY	EVERY 22 MINUTES

62. TELEMETRY REQUIREMENTS

150 KHZ VIDEO BANDWIDTH

63. ADVANTAGES AND LIMITATIONS

FULL EARTH DISK PHOTOGRAPHY. EARTH SYNCHRONOUS ORBIT ALLOWS COMPLETE STORM HISTORIES TO BE RECORDED.

64. REFERENCES

1) MET DATA CATALOG FOR ATS, VOL 1. GSFC, OCT 67.***2) SUOMI, V. E. AND PARENT, R.J.: PROPOSAL FOR A SPIN SCAN CAMERA SYSTEM FOR A SYNCHRONOUS SATELLITE. JULY 1965.***3) OSTROW, H. AND WEINSTEIN, O.: A REVIEW OF A DECADE OF SPACE CAMERA SYSTEMS DEVELOPMENT FOR MET. PRESENTED AT SOC OF PHOTO-OPTICAL ENGRS 13TH ANNUAL TECH SYMP. 23 AUG 68.***4) FILM DATA AVAIL FROM NAT WEATHER RECORD CTR

65. HISTORICAL REMARKS

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE		2. ACRONYM / ACRONYM
VHF TRANSPONDER		VTRAN
(TITLE CONT.)		4. RECORD DATE
		11/10/69 0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
CORRIGAN, J.P.	GODDARD SPACE FLT CENTER	301-982-2174
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. FINISH DATE	17. STATUS
	NAS5-9593		05/65	12/66	OPERATIONAL

18. MONITOR	19. AGENCY	20. PCM OFFICE	21. TELEPHONE
BURKE, J.R.	NASA HDQTRS	OSSA/SCS	202-962-0581

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
HUGHES AIRCRAFT CO R&D	CULVER CITY, CALIFORNIA	12/66	NA

26. INSTRUMENT TYPE

TRANSPONDER, ACTIVE FREQUENCY-TRANSLATION UNC

28. APPLICATION	29. SPACECRAFT
COMM, OCEAN	ATS 1

30. PURPOSE

PRIMARY-DEMONSTRATE FEASIBILITY OF PROVIDING CONTINUOUS VOICE COMMUNICATIONS LINK BETWEEN A GROUND CONTROL STATION AND AIRCRAFT WITHIN SATELLITE RANGE.***SECONDARY-DEMONSTRATE FEASIBILITY OF OPERATING A METEOROLOGICAL NETWORK IN WHICH DATA FROM SENSOR PACKAGES ARE COLLECTED AT A CENTRAL STATION AND THEN TRANSMITTED TO THE NETWORK ALL VIA SATELLITE.

31. PRINCIPLES OF OPERATION

THE VHF COMMUNICATIONS INSTRUMENT IS AN ACTIVE FREQUENCY-TRANSLATION LIMITING (CLASS C) REPEATER. THE REPEATER BOTH RECEIVES AND TRANSMITS THROUGH AN 8-ELEMENT, PHASED-ARRAY ANTENNA. INCOMING SIGNALS AT 149.22 MHZ ARE RECEIVED ON EACH DIPOLE ELEMENT ROUTED THROUGH A DIPLEXER, AMPLIFIED BY A LOW-NOISE RECEIVER, AND SHIFTED IN PHASE TO COMPENSATE FOR THE RELATIVE POSITION OF EACH DIPOLE ANTENNA. THE OUTPUTS OF EACH RECEIVER ARE IN PHASE ONLY FOR THOSE SIGNALS THAT ORIGINATE ON EARTH. REFERENCE SINUSOIDS USED TO DRIVE THE WAVEFORM GENERATOR ARE OBTAINED FROM THE SAME PHASED-ARRAY CONTROL ELECTRONICS USED TO AIM THE MICROWAVE BEAM TOWARD EARTH. THE 8 RECEIVER OUTPUTS ARE SUMMED TOGETHER, FILTERED, DOWN-CONVERTED TO AN IF FREQUENCY OF 29.95 MHZ, AMPLIFIED, AND PASSED THROUGH A CRYSTAL FILTER TO LIMIT THE RECEIVER BANDWIDTH TO 100 KHZ. THE IF IS THEN AMPLIFIED, UP-CONVERTED TO 135.6 MHZ, FURTHER AMPLIFIED, AND DIVIDED INTO 8 EQUAL PARTS. EACH OF THE 8 SIGNALS IS ROUTED TO A TRANSMITTER WHERE IT IS AMPLIFIED, PHASE-SHIFTED, AND FURTHER AMPLIFIED TO A POWER LEVEL OF 5 WATTS. EACH TRANSMITTER OUTPUT IS ROUTED THROUGH ITS RESPECTIVE DIPLEXER TO ONE OF THE ANTENNA ELEMENTS.

32. PHENOMENA OBSERVED

DATA FROM OBSERVATION PLATFORMS AND GROUND CONTROL STATIONS

33. MEASUREMENT RANGE

34. PRECISION AND ACCURACY

RECEIVER NOISE FIGURE < 4.0 DB

135.6 TO 149.22 MHZ NA

17.3 DEG LIMB-TO-LIMB(9700 NM) FROM GEO-SYNCH ALT

NA NA

NA NA SYNCH CIRCULAR EQUATORIAL POSIGRADE

8 ANTENNA SYSTEMS, 8 RECEIVERS, 8 TRANSMITTERS, AND MISC EQUIP

30 LB 90 WATTS

SOURC/SEN

NA REALTIME TELEMETRY CONTINUOUS

100 KHZ BANDWIDTH

1) VHF REPEATER EXPERIMENT-FINAL REPORT. HUGHES AIRCRAFT CO. NASA CONTRACT NO. 5-9593, FEB 1, 1967.***2) VHF REPEATER EXPERIMENT FOR ATS-C, FINAL REPORT. HUGHES AIRCRAFT CO., NASA CONTRACT NO. NAS 5-10290, NOV 1967.

SIMILAR TO INSTRUMENT FLOWN ON ATS 3.

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE: WEATHER FACSIMILE EXPERIMENT
2. ACRONYM: WEFAX
3. EXP NO:
(TITLE CONT.)
4. RESUME DATE: 11/10/69
5. CARD NO: 0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
WISHNA, S.	GODDARD SPACE FLT CENTER	301-982-5774
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
HOLMES, D.W.	ESSA/NESC	301-982-5774

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
	NAS5-9593			12/66	OPERATIONAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
BURKE, J.R.	NASA HDQTRS	OSSA/SCS	202-962-0581

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD T.M.
HUGHES AIRCRAFT CO	EL SEGUNDO, CALIFORNIA	12/66	NA

26. INSTRUMENT TYPE: TRANSPONDER — UNC

28. APPLICATION	29. SPACECRAFT
MET, COMM	ATS 1

30. PURPOSE

PRIMARY-TO DETERMINE OPERATIONAL FEASIBILITY OF DISSEMINATING METEOROLOGICAL DATA AND SATELLITE CLOUD CAMERA PICTURES FROM A CENTRAL SOURCE TO WIDELY SCATTERED RECEIVING UNITS UTILIZING A VHF TRANSPONDER SYSTEM ONBOARD AN EARTH SYNCHRONOUS SPACECRAFT. ***SECONDARY- TO EXPLORE FEASIBILITY OF INCREASING THE AMOUNT OF DATA AVAILABLE TO STATIONS RECEIVING APT PHOTOGRAPHS.

31. PRINCIPLES OF OPERATION

THIS WEFAX EXPERIMENT, WHICH IS SIMILAR TO THE ONE UTILIZED BY ATS 3, IS DIFFERENT FROM OTHER ATS 1 METEOROLOGICAL EXPERIMENTS IN THAT IT HAS NO UNIQUE FLYING HARDWARE. IT IS PART OF THE ATS 1 VHF EXPERIMENT AND USES THE VHF TRANSPONDER AS A DATA RELAY. THIS TRANSPONDER RECEIVES AT 149.22 MHZ AND TRANSMITS AT 135.60 MHZ. THE TESTS CONDUCTED AS PART OF WEFAX INCLUDE: MASS DISTRIBUTION OF WEATHER DATA DIRECT TO APT USERS; REBROADCASTING SYNCHRONOUS ALTITUDE EARTH PICTURES VIA APT FORMAT; PROPOSED MASS COLLECTIONS OF HYDROLOGY DATA VIA ATS 1 RELAY; AND PROPOSED LINE ISLANDS EXPERIMENT BY THE NAT CTR FOR ATMOS RES. IN OPERATION, WEATHER FACSIMILE CHARTS AND SATELLITE CLOUD COVER PICTURES ARE SENT PERIODICALLY VIA LANDLINE FROM THE NAT MET CTR, ESSA, AT SUITLAND, MD., TO THE NASA ATS GROUND STATION AT MOJAVE CALIF. FROM THERE, THE PROCESSED INFORMATION IS TRANSMITTED TO ATS 1 FOR RELAY TO ALL PARTICIPATING APT STATIONS WITHIN THE RECEPTION AREA. DAILY WEFAX SCHEDULES ARE PROGRAMMED TO PROVIDE MEANINGFUL DATA TO THE MAXIMUM NUMBER OF PARTICIPATING APT STATIONS POSSIBLE, NUMBERING ABOUT 50.

32. PHENOMENA OBSERVED

VHF TRANSMISSIONS FROM ATS GROUND STATIONS GIVING WEATHER DATA

33. MEASUREMENT RANGE

34. PRECISION AND ACCURACY

TRANSPONDER NOISE FIGURE 4.5 DB; BANDWIDTH 100 KHZ

35. SPECTRAL RANGE: 149.22 AND 135.60 MHZ

36. SPECTRAL RESOLUTION

37. FIELD OF VIEW: 17.3

38. GROUND SWATH: DEG LIMB-TO-LIMB (9700 NM) FROM GEO-SYNCH ALT

42. PGM INT. ORBIT: SYNCH CIRCULAR EQUATORIAL POSIGRADE

46. SPACECRAFT ATTITUDE REQUIREMENTS:

47. COMPONENTS: VHF TRANSPONDER, ANTENNA SYSTEM, DIPLEXER

48. SPACECRAFT POWER: 29 LB

51. TRANSMISSION FREQUENCY BAND: SOURC/SEN

52. DATA RECORDER:

53. OBSERVATION: AS PROGRAMMED

54. DATA RATE: 3 KHZ INFORMATION BANDWIDTH

56. ADVANTAGES AND LIMITATIONS

MULTIPLEXING TO ENABLE ADDITIONAL DATA TO BE TRANSMITTED HAS NOT BEEN COMPLETELY SUCCESSFUL.

64. REFERENCES

1) ALLIED RES ASSOC, INC.: NASA/ESSA WEFAX EXPERIMENT EVALUATION REPORT (ATS 1), CHANGE NO.4, N68-12990.***2) MINZNER, R.A. ED: INTERIM REPORT ON SAT MET INSTRUMENTS, PM-6713, NASA-ERC, CAMBRIDGE MASS., 1967.***3) ATS B PRESS KIT NASA RELEASE NO. 66-308, DEC, 1966.***4) DRUMMOND, R.R.: WEATHER FACSIMILE EXPT. PRESENTED AT ATS SYSTEMS ENGRS TRAINING PRO, GSFC, SEPT. 66.

65. HISTORICAL REMARKS: SIMILAR TO ATS 3 WEFAX.

ATS 2

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE: ADVANCED VIDICON CAMERA SYSTEM
2. ACRONYMS: AVCS
(TITLE CONT.)
4. RECEIVED DATE: 11/10/69 0005
6. PRINCIPAL INVESTIGATOR: OSTROW, H.
7. AFFILIATION: GODDARD SPACE FLT CENTER
8. TELEPHONE: 301-982-6563
9. CO-INVESTIGATOR
10. AFFILIATION
11. TELEPHONE
12. CONTRACT TYPE
13. CONTRACT NUMBER
14. MANUFACTURER NUMBER OR NAME
15. START DATE
16. STATUS: 02/67 POST FLIGHT
18. MONITOR: BURKE, J.R.
19. AFFILIATION: NASA HDQTRS
20. OFFICE: OSSA/SCS
21. TELEPHONE: 202-962-0581
22. VENDOR: RCA ASTRO-ELECTRONICS
23. LOCATION: PRINCETON, NEW JERSEY
24. FLIGHT DATE: 04/67
25. LEAD TIME: NA
26. INSTRUMENT TYPE: IMAGER, 1-INCH WIDE-ANGLE HIGH-RESOLUTION VIDICON
UNC
28. APPLICATION: MET
29. SPACECRAFT: ATS 2
30. PURPOSE

PRIMARY- TO EVALUATE THE EFFECT THE CAMERA SHUTTER AND TAPE RECORDER MOVEMENTS HAVE ON THE SATELLITES POINTING ACCURACY;*** SECONDARY- TO PHOTOGRAPH THE ENTIRE EARTH'S DISK TO STUDY THE UTILITY OF FUTURE PHOTOS FROM GRAVITY GRADIENT SATELLITES AT HIGH ALTITUDE

31. PRINCIPLES OF OPERATION

THE AVCS IS SIMILAR TO THE CAMERA FLOWN ON NIMBUS 1 AND 2, AND ESSA 3 AND 5. TWO CAMERS, IDENTICAL EXCEPT FOR OPTICS ARE ON BOARD ATS 2. ONE CAMERA HAS A WIDE-ANGLE (50 DEG), LOW-RESOLUTION 12 MM LENS, CAPABLE OF VIEWING THE FULL EARTH DISK WITH 10 MILE RESOLUTION AT PICTURE CENTER. THE OTHER HAS A NARROW ANGLE (3 DEG) HIGH-RESOLUTION 200 MM LENS, WITH 0.5 MI RESOLUTION AT CENTER. PICTURES FROM EITHER CAMERA CAN BE STORED ON A 4-CHANNEL TAPE RECORDER OR RELAYED DIRECTLY TO TRACKING STATIONS. EACH CAMERA CONTAINS THE LENS ASSEMBLY, A HIGH-RESOLUTION VIDICON TUBE, FOCAL-PLANE SHUTTER ASSEMBLY, FLASH TOBE TO ERASE IMAGE AND PRISM ASSEMBLY, SUN SENSOR AND YOKE, AND PREAMPLIFIER ASSEMBLIES. THE CAMERA CONVERTS THE OPTICAL IMAGE TO AN ELECTRICAL SIGNAL WHICH IS PROCESSED AND EITHER RELAYED DIRECTLY TO EARTH OR STORED ON TAPE. THE VIDICON HAS AN INHERENT STORAGE PROPERTY WHICH PERMITS A NOMINAL 6.5 SEC FRAME SCAN TIME. CONCURRENT WITH SHUTTER ACTUATION A 16-INCREMENT GRAY SCALE IS INCLUDED AT THE EDGE OF EACH PICTURE FRAME AS A CONTRAST CHECK. THE SPACECRAFT FAILED TO TO ACHIEVE PROPER ORBIT AND ITS TRANSMITTERS WERE SILENCED OCTOBER 23, 1967.

32. PHENOMENA OBSERVED: CLOUD COVER OF EARTH VIA REFLECTED VISIBLE SOLAR RADIATION
33. MEASUREMENT RANGE: 4 TO 10,000 FOOT-LAMBERTS
34. PRECISION AND ACCURACY: RESOLUTION APPROXIMATELY 800 LINES WITH 16 LEVELS OF GRAY

35. SPECTRAL RESPONSE: 0.45 TO 0.65 MICRON
36. SPECTRAL RESOLUTION: NA
37. TIME CONSTANT: 40. MILLSEC
38. GROUND RESOLUTION: SEE ITEM 31
39. GROUND SWATH: SEE ITEM 31
40. DATA RATE: SEE ITEM 31
44. ALTITUDE
45. INCLINATION: HIGH ECCENTRIC: MEDIUM POSIGRADE
46. SPACECRAFT REQUIREMENTS
47. WEIGHT: 2 CAMERAS WITH ASSOCIATED OPTICS, ELECTRONICS, TAPE RECORDER
48. VOLUME
50. AVERAGE POWER: 135 LB
51. STANDBY POWER
52. PEAK POWER: 22 WATTS
53. MTBF
54. MAGNETIC FIELD
55. NUCLEAR INTERFERENCE
57. THERMAL INTERFERENCE
58. SHIELDING: SENSITIVE
MAGNETIC SHIELDING
59. CALIBRATION
60. DATA RECOVERY: GRAY SCALE ON EACH PIC
61. FREQUENCY OF OBSERVATION: REALTIME OR DELAYED
EVERY 5-10 MINUTES
62. GROUND REQUIREMENTS: READOUT TIME 6.25 SEC, VIDEO BANDWIDTH 60 KHZ.
63. ADVANTAGES AND LIMITATIONS: SPACECRAFT FAILED TO ACHIEVE DESIRED ORBIT, LIMITING THE USEFULNESS OF THE EXPERIMENT.
64. REFERENCES

1) METEOROLOGICAL DATA CATALOG FOR THE ATS, VOL 2, GSFC, 1968.*** 2) PRESS KIT-PROJECT ATS-A, NASA RELEASE NO: 67-71, NASA WASH.D.C MARCH 1967.***3) EASTMAN, F.H.: TWO CAMERA ADVANCED VIDICON CAMERA SUBSYSTEM (AVCS) FOR THE APPLICATIONS TECHNOLOGY SATELLITE. PRESENTED AT ATS EUG TRAINING PGM, GSFC, AUG 22-SEPT 30, 1966. ***4) DATA AVAILABLE FROM NASA-GSFC, ATTN: NADUC, CODE 460.

65. HISTORICAL REMARKS: SATELLITE DID NOT ACHIEVE ORBIT.
66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
MICROWAVE TRANSPONDER	MTRAN	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
DARCEY, R.J.	GODDARD SPACE FLT CENTER	301-982-4094
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. TRASH INDEX NUMBER	15. START DATE	16. TERMINATION DATE	17. STATUS
				02/67	POST FLIGHT

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
BURKE, J.R.	NASA HDQTRS	OSSA/SCS	202-962-0581

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
HUGHES AIRCRAFT CO	EL SEGUNDO, CALIFORNIA	04/67	NA

26. INSTRUMENT TYPE	27. NEW
TRANSPONDER, 6-GHZ (RECEIVE) 4-GHZ (TRANSMIT) SHF	UNC

28. APPLICATION	29. SPACECRAFT
COMM	ATS 2

30. PURPOSE

PRIMARY- TO EVALUATE SIMULTANEOUS TRANSMISSION OF VOICE, TELEVISION, TELEGRAPH, AND DIGITAL DATA TO SEVERAL GROUND STATIONS. ***SECONDARY- TO DETERMINE EFFECTS OF DOPPLER SHIFT DUE TO SATELLITE MOTION ON MULTIPLE ACCESS EQUIPMENT AND COMPARE EFFECTS WITH STATIONARY SATELLITE.

31. PRINCIPLES OF OPERATION

THIS SYSTEM IS SIMILAR TO THOSE FLOWN ON ATS-1 AND ATS-3. RECEIVING AND TRANSMITTING ANTENNAS AND TRAVELING-WAVE-TUBE POWER AMPLIFIERS ARE USED IN CONJUNCTION WITH A DUAL MODE COMMUNICATIONS TRANSPONDER TO PROVIDE A SYSTEM ELEMENT CAPABLE OF ACCEPTING AND HANDLING ANY TYPE OF COMMUNICATIONS TRAFFIC OR WIDEBAND COMMUNICATIONS. THE FREQUENCY TRANSLATION MODE IS DESIGNED PRIMARILY FOR TELEVISION OR OTHER WIDEBAND USAGE IN WHICH ONE GROUND TRANSMITTER UTILIZES THE COMPLETE CHANNEL. THE USABLE BANDWIDTH IS 25 MHZ. THE MULITPLE ACCESS MODE IS DESIGNED TO PERMIT THE INTERCONNECTION OF A LARGE NUMBER OF GROUND STATIONS IN A HIGH CHANNEL CAPACITY FREQUENCY DIVISION MULTIPLEX SYSTEM. THE TRANSPONDER SERVES AS A TELEPHONE RELAY. FREQUENCY DIVISION MULTIPLEXING OF THE VOICE CHANNELS WITH SSB IS USED FOR THE VARIOUS GROUND-TO-SPACECRAFT LINKS. THESE SIGNALS ARE CONVERTED INTO PHASE MODULATION OF A SINGLE CARRIER IN THE SPACECRAFT AND ARE RETRANSMITTED TO ALL STATIONS IN THIS FORM. EACH GROUND STATION SELECTS THE APPROPRIATE CHANNELS FROM THE RECOVERED BASEBAND CONTAINING ALL CHANNELS TO COMPLETE THE TWO-WAY INTERCONNECTIONS. THE ANTENNA USED ON THIS FLIGHT WAS DIRECTIVE HORN AND DIFFERED FROM ATS 1.

32. PHENOMENA OBSERVED

TRANSMISSIONS FROM ATS GROUND STATIONS AT 6 GHZ

33. MEASUREMENT RANGE

34. PRECISION AND ACCURACY

NA

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
6.212 TO 6.301 GHZ	25. MHZ	

38. FIELD OF VIEW	39. GROUND SWATH
18.0 BY 23.0 DEG	LIMB-TO-LIMB (9500 NM) FROM GEO-SYNCH ALT

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
NA	NA

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
NA	NA	HIGH ECCENTRIC	MEDIUM POSIGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

TRANSPONDER, ANTENNA

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
SOURC/SEN			SENSITIVE	

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
NA	REALTIME TELEMETRY	WHEN IN VIEW

62. TELEMETRY REQUIREMENTS

NA

63. ADVANTAGES AND LIMITATIONS

SATELLITE DID NOT ACHIEVE PROPER ORBIT; STABILIZATION DID NOT WORK PROPERLY

64. REFERENCES

1) PROJECT DEVELOPMENT PLAN-ATS, GSFC, GREENBELT, MD. DEC. 1965. ***2) METEOROLOGICAL DATA CATALOG FOR ATS VOL 2. GSFC. GREENBELT MD., 1968.***3) TECHNICAL DATA REPORT FOR THE ATS PROGRAM. GSFC, SECION 5, 1968.

65. HISTORICAL REMARKS

SIMILAR TO THAT ON ATS 1 AND 3. SATELLITE DID NOT ACHIEVE ORBIT.

66. FOLLOWS

ATS 3

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE		2. ACRONYM	EXP NO
IMAGE-DISSECTOR CAMERA SYSTEM		IDCS	
(TITLE CONT.)		4. RESUME DATE	
		11/10/69 0005	

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
BRANCHFLOWER, G.A.	GODDARD SPACE FLT CENTER	301-982-5539
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
FOOTE, R.H.	ITT INDUSTRIAL LABS	

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. TERM DATE	17. STATUS
	NAS5-9671				11/67 OPERATIONAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
BURKE, J.R.	NASA HDQTRS	OSSA/SAS	202-962-0581

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
ITT INDUSTRIAL LABS	FORT WAYNE, INDIANA	11/67	NA

26. INSTRUMENT TYPE

IMAGER, 1-INCH VISIBLE ELECTRICALLY-SCANNING PHOTOCATHODE UNC

28. APPLICATION	29. SPACECRAFT
MET	ATS 3

30. PURPOSE

PRIMARY- TO TRANSMIT IN REAL TIME, DAYLIGHT CLOUD COVER INFORMATION FROM THE MAJOR PORTION OF THE FULL EARTH DISK, AND TO EVALUATE THE OPERATIONAL CHARACTERISTICS OF THE IDC IN A SPACE ENVIRONMENT, I.E. HOW ELECTRICAL SCANNING, AS OPPOSED TO MECHANICAL SCANNING, WILL PERFORM IN SPACE.

31. PRINCIPLES OF OPERATION

A SIMILAR SYSTEM IS SCHEDULED TO FLY ON NIMBUS D, AND IS FLYING ON NIMBUS 3. THE 1-INCH IMAGE DISSECTOR HAS A RESOLUTION CAPABILITY OF 1300 TV-LINES. IT OPERATES IN A LINE-SCAN MODE AND CONTAINS A PHOTOCATHODE THAT IS MASKED OFF TO FORM A SLIT SLIGHTLY WIDER THAN A LINE. A SCENE IS OPTICALLY FOCUSED ON THE PHOTOCATHODE AND PHOTOELECTRONS ARE EMITTED FROM THE SURFACE IN PROPORTION TO THE INCIDENT ILLUMINATION. THE PHOTOELECTRONS ARE ACCELERATED AND FOCUSED ON A PLANE WHICH CONTAINS A PIN-HOLE APERTURE. THE ELECTRON IMAGE IS DEFLECTED PAST THE APERTURE BY MEANS OF MAGNETIC DEFLECTION. THE APERTURE SAMPLES THE ELECTRON IMAGE AND A SECONDARY-EMISSION ELECTRON-MULTIPLIER SECTION AMPLIFIES THE SIGNAL BY ABOUT 10 MILLION. THE CAMERA IS MOUNTED WITH ITS OPTICAL AXIS PERPENDICULAR TO THE SATELLITE'S AND EARTH'S ROTATIONAL AXIS. THE CAMERA'S OPTICAL AXIS TRACES A PATH ON THE EARTH FROM WEST TO EAST AS THE SATELLITE ROTATES. THE CAMERA SCANS A PROGRESSION OF LINES, ONE PER SATELLITE ROTATION, UNTIL A COMPLETE RASTER IS GENERATED. COVERAGE FROM 50 N TO 50 S LATITUDE IS OBTAINED, WITH A GROUND RESOLUTION AT THE NADIR OF 3.8 NM. SCAN LINES CAN BE TRACED EITHER PARALLEL OR PERPENDICULAR TO THE SPIN AXIS OF THE EARTH.

32. PHENOMENA OBSERVED

REFLECTED SUNLIGHT FROM THE EARTH'S SURFACE AND CLOUD COVER

33. MEASUREMENT RANGE

100 TO 1000 FOOT-LAMBERTS

34. PRECISION AND ACCURACY

40 DB AT 10,000 FOOT-LAMBERTS

35. SPECTRAL RESPONSE CONSTANT

0.4 TO 0.7 MICRON

37. FOV/SWATH

14.6 BY 14.6 DEG LINE-TO LINE (6040 NM) FROM GEO-SYNCH ALT

0.01 DEG 3.8 NM AT CENTER

ALTITUDE

SYNCH CIRCULAR EQUATORIAL POSIGRADE

IMAGE DISSECTOR, SCANNING APERTURE, 12 STAGE ELECTRON MULTIPLIER

AVG SAT POWER

20 LB 0.38 CU FT 20 WATTS

49. DATA RECOVERY

REALTIME TELEMETRY EVERY 10 MINUTES

51. SPECIAL REQUIREMENTS

LESS THAN 100 KHZ AT 100 RPM SATELLITE SPIN RATE.

52. ADVANTAGES/DISADVANTAGES

CAN OVERCOME EFFECTS OF SATELLITE SPIN AXIS NUTATION WITH PROPER DATA PROCESSING; DAYLIGHT USE ONLY

54. REFERENCES

1) BRANCHFLOWER, G. FOOTE, R., FIGGINS, F.: THE APPLICATIONS TECHNOLOGY SATELLITE IMAGE DISSECTOR CAMERA EXPERIMENT, NASA TN-4186, NOV. 1967.***2) ATS TECHNICAL DATA REPORT, SECTION 8.5, GSFC, JUNE 68.***3) METEOROLOGICAL DATA CATALOG FOR THE ATS, VOL 2 GSFC, 1968.***4) DATA AVAILABLE FROM THE NATIONAL WEATHER RECORDS CENTER, ESSA, ASHEVILLE, N.C.

55. HISTORICAL REMARKS

SIMILAR TO NIMBUS D AND 3 IDCS.

56. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
MICROWAVE TRANSPONDER	MTRAN	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
DARCEY, R.J.	GODDARD SPACE FLT CENTER	301-982-4094
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
				11/67	OPERATIONAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
BURKE, J.R.	NASA HDQTRS	OSSA/SCS	202-962-0581

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
HUGHES AIRCRAFT CO	EL SEGUNDO, CALIFORNIA	11/67	NA

26. INSTRUMENT TYPE	27. SECURITY
TRANSPONDER, 6-GHZ (RECEIVE) 4-GHZ (TRANSMIT) SHF	UNC

28. APPLICATION	29. SPACECRAFT
COMM	ATS 3

30. PURPOSE

PRIMARY- TO EVALUATE SIMULTANEOUS TRANSMISSION OF VOICE, TELEVISION, TELEGRAPH, AND DIGITAL DATA TO SEVERAL GROUND STATIONS. ***SECONDARY- TO DETERMINE EFFECTS OF DOPPLER SHIFT DUE TO SATELLITE MOTION ON MULTIPLE ACCESS EQUIPMENT AND COMPARE EFFECTS WITH STATIONARY SATELLITE.

31. PRINCIPLES OF OPERATION

THE SYSTEM IS SIMILAR TO THOSE FLOWN ON ATS-1 AND ATS-2. RECEIVING AND TRANSMITTING ANTENNAS AND TRAVELING-WAVE-TUBE POWER AMPLIFIERS ARE USED IN CONJUNCTION WITH A DUAL MODE COMMUNICATIONS TRANSPONDER TO PROVIDE A SYSTEM ELEMENT CAPABLE OF ACCEPTING AND HANDLING ANY TYPE OF COMMUNICATIONS TRAFFIC OR WIDEBAND COMMUNICATIONS. THE FREQUENCY TRANSLATION MODE IS DESIGNED PRIMARILY FOR TELEVISION OR OTHER WIDEBAND USAGE IN WHICH ONE GROUND TRANSMITTER UTILIZES THE COMPLETE CHANNEL. THE USABLE BANDWIDTH IS 25 MHZ. THE MULTIPLE ACCESS MODE IS DESIGNED TO PERMIT THE INTERCONNECTION OF A LARGE NUMBER OF GROUND STATIONS IN A HIGH CHANNEL CAPACITY FREQUENCY DIVISION MULTIPLEX SYSTEM. THE TRANSPONDER SERVES AS A TELEPHONE RELAY. FREQUENCY DIVISION MULTIPLEXING OF THE VOICE CHANNELS WITH SSB IS USED FOR THE VARIOUS GROUND-TO-SPACECRAFT LINKS. THESE SIGNALS ARE CONVERTED INTO PHASE MODULATION OF A SINGLE CARRIER IN THE SPACECRAFT AND ARE RETRANSMITTED TO ALL STATIONS IN THIS FORM. EACH GROUND STATION SELECTS THE APPROPRIATE CHANNELS FROM THE RECOVERED BASEBAND CONTAINING ALL CHANNELS TO COMPLETE THE TWO-WAY INTERCONNECTIONS. THE ANTENNA USED IS A MECHANICALLY DESPUN PHASED ARRAY GIVING 15-18 DB OF GAIN. THE EFFECTIVE RADIATED POWER IS 830 W.

32. PHENOMENA OBSERVED

TRANSMISSIONS FROM ATS GROUND STATIONS AT 6 GHZ

33. MEASUREMENT RANGE

34. PRECISION AND ACCURACY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
6.212 TO 6.301 GHZ	25. MHZ	

38. FIELD OF VIEW	39. GROUND SWATH
18.0 BY 23.0 DEG	LIMB-TO-LIMB (9500 NM) FROM GEO-SYNCH ALT

40. ANGULAR RESOLUTION 41. SPATIAL RESOLUTION

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		SYNCH CIRCULAR	EQUATORIAL POSIGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

TRANSPONDER, ANTENNA

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
SOURC/SEN		SENSITIVE		

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
NA	REALTIME TELEMETRY	CONTINUOUS

62. TELEMETRY REQUIREMENTS

NA

63. ADVANTAGES AND LIMITATIONS

64. REFERENCES

1) NASA PRESS KIT, ATS-C, RELEASE NO.67-276,OCT. 1967.***2) PROJECT DEVELOPMENT PLAN-APPLICATIONS TECHNOLOGY SATELLITE, GSFC, GREENBELT, MD.***3) TECHNICAL DATA REPORT FOR THE ATS PROGRAM, GSFC, 1968.

65. HISTORICAL REMARKS

THE SYSTEM IS SIMILAR TO THOSE FLOWN ON ATS 1, 2, 4 AND 5.

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXPAND
OMEGA POSITION-AND-LOCATION EQUIPMENT EXPERIMENT	OPLE	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0003

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
LAUGHLIN, C.	GODDARD SPACE FLT CENTER	301-982-6962
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
HILTON, G.E.	GODDARD SPACE FLT CENTER	301-982-6969

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. TERMINATION DATE	17. STATUS
				11/67	OPERATIONAL

18. MONITOR	19. AGENCY	20. FROM OFFICE	21. TELEPHONE
BURKE, J.R.	NASA HDQTRS	OSSA/SCS	202-962-0581

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
HUGHES AIRCRAFT CO	EL SEGUNDO, CALIFORNIA	11/67	NA

26. INSTRUMENT TYPE	27. MOD. NO.
TRANSPONDER, VHF	UNC

28. APPLICATION	29. SPACECRAFT
MET, OCEAN, NAV	ATS 3

30. PURPOSE

PRIMARY - TO DEMONSTRATE THE FEASIBILITY OF USING THE OMEGA NAVIGATIONAL SYSTEM IN CONJUNCTION WITH SYNCHRONOUS SATELLITES TO ESTABLISH A GLOBAL LOCATION AND DATA COLLECTION SYSTEM.

31. PRINCIPLES OF OPERATION

AN OPERATIONAL SYSTEM CONSISTS OF: (1) AN OPLE CONTROL CENTER; (2) A SYNCHRONOUS SATELLITE; AND (3)THE OPLE PLATFORM ELECTRONIC PACKAGES (PEP'S) WORKING IN CONJUNCTION WITH THE OMEGA NETWORK. DURING A TYPICAL INTERROGATION PERIOD, GSFC TRANSMITS A PRE-PROGRAMMED PLATFORM INTERROGATION SEQUENCE WHICH IS RELAYED (VHF) VIA ATS TO OPLE PLATFORMS THE ATS 3 VHF TRANSPONDER RECEIVES AT 149.22 MHZ AND TRANSMITS AT 135.6 MHZ WITH A 40-WATT MAX OUTPUT. IT CAN OPERATE ALSO IN THE 450 MHZ BAND. EACH PLATFORM HAS ITS OWN BINARY CODE ADDRESS. AFTER RECEIPT OF THEIR OWN PROPER ADDRESSES, THE CORRECTLY ADDRESSED PEP'S SIMULTANEOUSLY TRANSMIT THEIR ASSIGNED ACQUISITION REFERENCE A/R SIGNALS. AFTER THE ACQUISITION PERIOD, THE A/R TONE IS MODULATED WITH METEOROLOGICAL OR PLATFORM STATUS DATA BY PHASE-SHIFT KEYING. FOLLOWING THE DATA TRANSMISSION PERIOD, THE A/R TONE IS REDUCED IN POWER LEVEL AND THE OMEGA TRANSMISSION MODE IS INITIATED. IN THIS MODE, TWO PAIRS OF VLF OMEGA SIGNALS ARE RECEIVED BY THE RECEIVERS ON THE PLATFORMS AND CONVERTED TO VHF FOR TRANSMISSION TO ATS 3 AND THEN GODDARD. THE RELATIVE PHASE BETWEN THE TWO SIGNALS OF A PAIR DETERMINE A LINE AND THE INTERSECTION OF THE 2 LINES GIVE THE LOCATION TO WITHIN 1 MI (DAYTIME), 2 MI (NIGHT).

32. PHENOMENA OBSERVED

DATA FROM OBSERVATION PLATFORMS

33. MEASUREMENT RANGE

34. PRECISION AND ACCURACY

POSITION TO ONE MILE IN DAYTIME; TWO MILES NIGHTTIME

35. SPECTRAL RANGE

SEE ITEM 31

36. SPECTRAL RESOLUTION	37. TIME CONSTANT

38. FIELD OF VIEW	39. GROUND SWATH
17.0 DEG	LIMB-TO-LIMB (1000 NM) FROM GEO-SYNCH ALT

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
NA	NA

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
4. DEG		SYNCH CIRCULAR	EQUATORIAL POSIGRADE

46. SPECIAL REQUIREMENTS

47. SUBSYSTEMS

PLATFORM ELECTRONIC PACKAGES, BATTERY, DIPOLE ANTENNA.

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
45 LB		90 WATTS			

54. ATTITUDE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
SOURC/SEN				

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
NA	NA	AS PROGRAMMED

62. TELEMETRY MEASUREMENTS

56 BITS PER SECOND PHASE SHIFT KEYED

63. ADVANTAGES AND LIMITATIONS

COMPLEX AND BULKY LOCATION-COMPUTING EQUIPMENT CAN BE LOCATED AT CONVENIENT CENTER RATHER THAN AT PLATFORM.

64. REFERENCES

1) ATS C PRESS KIT, ATS VOL 1-6, NASA RELEASE NO. 67-276, OCT 1967.***2) ATS TECHNICAL DATA REPORT, GODDARD SPACE FLIGHT CENTER, GREENBELT, MD. SECTION 8.4.1, JUNE 1968.***3) LAUGHLIN, C. ET AL: OMEGA POSITION-LOCATION EQUIPMENT (OPLE). PRESENTED AT ATS SYSTEMS ENGRS TRAINING PROGRAM, GSFC, SEPT. 1966.

65. HISTORICAL REMARKS

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
SPIN-SCAN CLOUD-COVER CAMERA	SSCC	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
MULTICOLOR	11/10/69	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
SUOMI, DR. V.E.	UNIVERSITY OF WISCONSIN	608-262-5938
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
PARENT, DR. R. J.	UNIVERSITY OF WISCONSIN	608-262-5939

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
				11/67	OPERATIONAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
BURKE, J.R.	NASA HDQTRS	OSSA/SCS	202-962-0581

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
SANTA BARBARA RCS CTR	GOLETA, CALIFORNIA	11/67	NA

26. INSTRUMENT TYPE	27. DISCIPLINE
IMAGER, THREE 1-INCH PHOTOMULTIPLIERS, VISIBLE-COLOR	UNC

28. APPLICATION	29. SPACECRAFT
MET	ATS 3

30. PURPOSE

PRIMARY- TO OBTAIN HIGH RESOLUTION COLOR PHOTOGRAPHS FROM SYNCHRONOUS ALTITUDE SO THAT CLOUD DEVELOPMENT, CLOUD DISPLACEMENTS, AND IN THE TERMINATOR ZONE, CLOUD ALTITUDES, CAN BE DETERMINED FOR USE IN STUDIES OF TROPICAL CONVECTION.***SECONDARY-DETERMINE HORIZONTAL EXTENT OF OCEAN CURRENTS; SCATTERING OF THE ATMOSPHERE IN BROAD SPECTRAL BANDS; VIEW MID-LATITUDE STORMS.

31. PRINCIPLES OF OPERATION

THE MULTI-COLOR SPIN SCAN CAMERA IS AN ADVANCEMENT OVER THE MONOCHROMATIC SPIN SCAN CAMERA ON ATS 1. VISIBLE LIGHT REFLECTED FROM THE EARTH IS GATHERED BY A 5-INCH DIAMETER F/3 DALL-KIRKHAM TELESCOPE AND FOCUSED ALTERNATELY ON A SET OF THREE 0.0015 INCH DIAMETER FIELD-DEFINING APERTURES. AN APERTURE PASSES EITHER RED, GREEN, OR BLUE DETERMINED BY A COMBINATION OF THE NATURAL CUTOFFS OF THE DIFFERENT DETECTOR PHOTOCATHODES, CORNING FILTER-GLASS DIVERGING LENSES AND INTERFERENCE FILTERS. THE SPINNING MOTION OF THE SPACECRAFT PROVIDES THE CAMERA SCAN PARALLEL TO THE EQUATOR. THE CAMERA STEPS ONE INCREMENT IN LATITUDE FOLLOWING EACH SPACECRAFT REVOLUTION PROVIDING POLE-TO-POLE COVERAGE IN 2400 SCAN LINES. WITH A SPIN RATE OF 100 RPM, THE TIME TO COVER ONE FRAME IS 24 MINUTES. RETRACE TAKES 4 MINUTES. THE SCAN CAN ALSO BE OPERATED IN A BACK-TO-BACK MODE. OPERATION HERE IS IDENTICAL TO THE NORMAL MODE DURING NORTH-TO-SOUTH OPERATION BUT DURING RETRACE THE SOUTH-TO-NORTH STEP IS AT THE SAME RATE AS THE FORWARD TRACE AND USEFUL VIDEO IS PRODUCED. THE OUTPUTS FROM THE THREE PHOTOTUBES ARE MULTIPLEXED AND TRANSMITTED TO EARTH OVER THE SHF WIDE-BAND LINK.

32. PHENOMENA OBSERVED

INTENSITY OF EARTH'S SPECTRAL REFLECTION IN THE BLUE, GREEN, RED

33. MEASUREMENT RANGE

34. PRECISION AND ACCURACY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.390 TO 0.700 MICRON		

38. FIELD OF VIEW	39. GROUND SWATH
15.0 BY 15.0 DEG	LIMB-TO-LIMB (10000 NM) FROM GEO-SYNCH ALT

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.006 DEG	2 NM AT CENTER

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
NA		SYNCH CIRCULAR	EQUATORIAL POSIGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

TELESCOPE, 3 PHOTOMULTIPLIER LIGHT DETECTORS, STEP DRIVE MECHANISM

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
23 LB	0.54 CU FT	10 WATTS		22 WATTS	

54. RFI INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
	REALTIME TELEMETRY	EVERY 28 MINUTES

62. TELEMETRY REQUIREMENTS

500 KBIT, 3 TDM CHANNELS OF 150 KBIT EACH.

63. ADVANTAGES AND LIMITATIONS

REDUCTION IN SIZE AND WEIGHT OVER COMBINED TELESCOPE-PHOTOMULTIPLIER TUBE ASSEMBLY.

64. REFERENCES

1) ATS METEOROLOGICAL DATA CATALOG. GSFC.***2) MINZNER, R.A. ED: INTERIM REPORT ON SATELLITE MET. INSTRUMENTS, PM-6713, NASA/ERC, PR67.***3) SUOMI, V. AND PARENT, R.J.: PROPOSAL AND SUPPLEMENT FOR SPIN SCAN CAMERA FOR ATS C. UNIV. OF WISC. NOV 65, JUN 66.***4) DATA AVAILABLE FROM ESSA, ASHEVILLE, N.C. FOR B/W AND AT NIMBUS/ATS DATA UTILIZATION CENTER, GSFC, FOR COLOR.

65. HISTORICAL REMARKS

ADVANCEMENT OVER MONOCHROMATIC SPIN-SCAN CAMERA (SSCC) ON ATS 1.

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
VHF TRANSPONDER	VTRAN	
(TITLE CONT.)	4. RESUME DATE	5. VERS NO
	11/10/69	0003

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
CORRIGAN, J. P.	GODDARD SPACE FLT CENTER	301-982-2174
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
	NAS5-10290		11/66	11/67	OPERATIONAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
BURKE, J.R.	NASA HDQTRS	OSSA/SCS	202-962-0581

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
HUGHES R AND D	CULVER CITY, CALIFORNIA	11/67	NA

26. INSTRUMENT TYPE — 27. SEC. CLASS: UNC

REPEATER, ACTIVE FREQUENCY TRANSLATION

28. APPLICATION	29. SPACECRAFT
COMM, OCEAN	ATS 3

30. PURPOSE

PRIMARY-DEMONSTRATE FEASIBILITY OF PROVIDING CONTINIOUS VOICE COMMUNICATIONS LINK BETWEEN A GROUND CONTROL STATION AND AIRCRAFT WITHIN SATELLITE RANGE.***SECONDARY-DEMONSTRATE FEASIBILITY OF OPERATING A METEOROLOGICAL NETWORK IN WHICH DATA FROM SENSOR PACKAGES ARE COLLECTED AT A CENTRAL STATION AND THEN TRANSMITTED TO THE NETWORK ALL VIA SATELLITE.

31. PRINCIPLES OF OPERATION

THE INSTRUMENT IS AN ACTIVE FREQUENCY TRANSLATION LINEAR REPEATER THAT RECEIVES AT A FREQUENCY OF 149.22 MHZ AND TRANSMITS AT A FREQUENCY OF 135.6 MHZ. THE REPEATER BOTH RECEIVES AND TRANSMITS THROUGH AN 8-ELEMENT, ELECTRONICALLY DESPUN PHASED-ARRAY ANTENNA OF THE TYPE USED ON THE ATS 1 VHF SYSTEM. THE ATS 3 TRANSMITTER IS A LINEAR AMPLIFIER, AS OPPOSED TO THE SATURATED AMPLIFIER OF ATS 1. INCOMING SIGNALS ARE RECEIVED ON EACH DIPOLE ELEMENT, ROUTED THROUGH A DIPLEXER, AMPLIFIED BY A LOW NOISE RECEIVER, AND SHIFTED IN PHASE TO COMPENSATE FOR THE RELATIVE POSITION OF EACH DIPOLE ANTENNA. THE OUTPUT OF EACH RECEIVER IS IN PHASE ONLY FOR THOSE SIGNALS THAT ORIGINATE ON EARTH. THE 8 RECEIVER OUTPUTS ARE SUMMED TOGETHER, FILTERED AND DOWN-CONVERTED TO A 29.95 MHZ IF. THE IF IS PASSED THROUGH A CRYSTAL FILTER TO LIMIT THE RECEIVER BAND WIDTH TO 100 KHZ. THE IF IS THEN AMPLIFIED AND UP-CONVERTED. EIGHT EQUAL OUTPUT LEVELS ARE OBTAINED BY A POWER SPLITTING, 7-WAY HYBRID. EACH OF THE SIGNALS IS THEN AMPLIFIED, PHASE SHIFTED AND FURTHER AMPLIFIELD TO AN OUTPUT LEVEL OF 5 WATTS. THE TRANSMITTER UNITS INTRODUCE A 3 DB ATTENUATION. EQUIPMENT CAN BE CONTROLLED EITHER BY GROUND STATION OR SPACECRAFT CLOCK.

32. PHENOMENA OBSERVED

DATA FROM OBSERVATION PLATFORMS AND GROUND CONTROL STATIONS

33. MEASUREMENT RANGE

34. PRECISION AND ACCURACY

RECEIVER NOISE FIGURE < 4.0 DB

35. SPECTRAL RANGE — 36. SPECTRAL RESOLUTION — TIME CONSTANT

135.6 TO 149.22 MHZ NA

36. FIELD OF VIEW — 36. GROUND SWATH

17.0 DEG LIMB-TO-LIMB(9700 NM) FROM GEO-SYNCH ALT

40. ANGULAR RESOLUTION — 41. SPATIAL RESOLUTION

NA NA

42. POINTING ACCURACY — 43. POINTING RATE — 44. ALTITUDE — 45. INCLINATION

NA NA SYNCH CIRCULAR EQUATORIAL POSIGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

8 ANTENNA SYSTEMS, 8 RECEIVERS, 8 TRANSMITTERS, AND MISC EQUIP

48. WEIGHT — 49. VOLUME — 50. AVERAGE POWER — 51. STANDBY POWER — 52. PEAK POWER — 53. MTBF

34 LB. 113 WATTS

54. RF INTERFERENCE — 55. MAGNETIC INTERFERENCE — 56. NUCLEAR INTERFERENCE — 57. THERMAL INTERFERENCE — 58. SHIELDING

SOURC/SEN

59. CALIBRATION — 60. DATA RECOVERY — 61. FREQUENCY OF OBSERVATION

NA REALTIME TELEMETRY CONTINUOUS

62. TELEMETRY REQUIREMENTS

100 KHZ BANDWIDTH

63. ADVANTAGES AND LIMITATIONS

MAJOR DIFFERENCE FROM ATS 1 CONFIGURATION IS THE ADDITION OF A SMALL ATTENUATOR TO EACH OF THE 8 ASSEMBLES.

64. REFERENCES

1) VHF REPEATER EXPERIMENT FOR ATS C, FINAL REPORT FOR CONTRACT NO. NAS5-10290. HUGHES AIRCRAFT CO, REPORT NO. P67-177, NOV 5, 1967.***2) VHF REPEATER EXPERIMENT, FINAL REPORT-NASA CONTRACT NO. NAS 5-10290. HUGHES AIRCRAFT CO, FEB 1967.

65. HISTORICAL REMARKS

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE: WEATHER FACSIMILE EXPERIMENT
2. ACRONYM: WEFAX
3. EXP NO:
(TITLE CONT.)
4. RESUME DATE: 11/10/69
5. REVISION: 0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
HOLMES, D.W.	ESSA/NESC	301-440-7405
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
WISHNA, S.	GODDARD SPACE FLT CENTER	301-982-5774

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
				11/67	OPERATIONAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
BURKE, J.R.	NASA HDQTRS	OSSA/SCS	202-962-0581

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
HUGHES AIRCRAFT CO	EL SEGUNDO, CALIFORNIA	11/67	NA

26. INSTRUMENT TYPE: TRANSPONDER, VHF
27. SECURITY: UNC

28. APPLICATION: MET, COMM
29. SPACECRAFT: ATS 3

30. PURPOSE

PRIMARY - TO TRANSMIT FACSIMILE WEATHER DATA THROUGH THE ATS 3 SATELLITE TO PARTICIPATING GROUND STATIONS***SECONDARY-TO TRANSMIT SELECTED SPIN-SCAN CAMERA PICTURES VIA SATELLITE TO APT GROUND READOUT STATIONS-TO EXPLORE FEASIBILITY OF INCREASING THE AMOUNT OF DATA AVAILABLE TO APT GROUND STATIONS FROM ESSA AND NIMBUS SATELLITES.

31. PRINCIPLES OF OPERATION

THIS WEFAX EXPERIMENT, WHICH IS SIMILAR TO THE ONE UTILIZED BY ATS 1, IS DIFFERENT FROM OTHER ATS 3 METEOROLOGICAL EXPERIMENTS IN THAT IT HAS NO UNIQUE FLYING HARDWARE. IT IS PART OF THE ATS 3 VHF EXPERIMENT AND USES THE VHF TRANSPONDER AS A DATA RELAY. THIS TRANSPONDER RECEIVES AT 149.22 MHZ AND TRANSMITS AT 135.60 MHZ. THE FEASIBILITY TESTS CONDUCTED BY WEFAX INCLUDE MASS DISTRIBUTION OF WEATHER DATA DIRECT TO APT USERS; REBROADCASTING SYNCHRONOUS ALTITUDE EARTH PICTURES VIA APT FORMAT; AND PROPOSED MASS COLLECTIONS OF HYDROLOGY DATA VIA ATS 3 RELAY. IN OPERATION, WEATHER FACSIMILE CHARTS AND SATELLITE CLOUD COVER PICTURES ARE SENT PERIODICALLY VIA LAND LINE FROM THE NATIONAL METEOROLOGICAL CENTER, ESSA, AT SUITLAND, MD., TO THE NASA ATS GROUND STATION AT MOJAVE, CALIFORNIA. FROM THERE THE WEFAX FIELD CENTER TRANSMITS THE DATA TO THE SPACECRAFT AT THE RATE OF 240 SCANS PER MINUTE, AND THE ATS THEN RELAYS THE DATA. PARTICIPATING APT STATIONS RECEIVE THESE TRANSMISSIONS AND EVALUATE THEM FOR USEFULNESS. COPIES OF THE RECEIVED ITEMS ARE SENT TO GODDARD FOR CORRELATING QUALITY WITH FACTORS SUCH AS TRANSMISSION DISTANCE AND ANTENNA ANGLE. POTENTIALLY 100 TO 150 RECEIVING SITES CAN BE INCLUDED IN THE AREA OF COVERAGE.

32. PHENOMENA OBSERVED: VHF TRANSMISSIONS FROM ATS GROUND STATIONS GIVING WEATHER DATA

33. MEASUREMENT RANGE:

34. PRECISION AND ACCURACY: TRANSPONDER NOISE FIGURE 4.5 DB, BANDWIDTH 100 KHZ

35. SPECTRAL RANGE: 149.22 AND 135.0 MHZ
36. SPECTRAL RESOLUTION
37. TIME CONSTANT
38. FIELD OF VIEW: 17.3 DEG
39. GROUND SWATH: LIMB-TO-LIMB (9700 NM) FROM GEO-SYNCH ALT
40. ANGULAR RESOLUTION
41. SPATIAL RESOLUTION
42. POINTING ACCURACY
43. POINTING RATE
44. ALTITUDE: SYNCH CIRCULAR EQUATORIAL POSIGRADE
45.
46. SPECIAL REQUIREMENTS:
47. COMPONENTS: VHF TRANSPONDER, ANTENNA SYSTEM, DIPLEXER
48. WEIGHT: 29 LB
49. VOLUME
50. AVERAGE POWER: 90 WATTS
51. STANDBY POWER
52. PEAK POWER
53. MTBF
54. RF INTERFERENCE
55.
56. MAGNETIC INTERFERENCE
57. NUCLEAR INTERFERENCE
58. THERMAL INTERFERENCE
59. SHIELDING: SOURC/SEN
60. CALIBRATION
61. DATA RECOVERY
62. MINIMUM DURATION OF OBSERVATION: APPROX 2 HOURS/DAY
63. TELEMETRY REQUIREMENTS: 2 KHZ INFORMATION BANDWIDTH
64. ADVANTAGES AND LIMITATIONS: MORE SENSITIVE TO SMALL SIGNALS THAN ATS 1 TRANSPONDER

65. REFERENCES

1) ATS C PRESS KIT, NASA RELEASE NO. 67-276, OCT., 1967.***2) CORRIGAN, J.P.: THE VHF EXPERIMENT, PRESENTED AT ATS SYSTEM ENGINEERING TRAINING PROGRAM, GSFC, AUG 1966.***3) DRUMMOND, R. WEATHER FACSIMILE EXPERIMENT. PRESENTED AT ATS SYSTEMS ENGRS. TRAINING PROGRAM, GSFC, SEPT 66.

66. HISTORICAL REMARKS: SIMILAR TO ATS 1 WEFAX.
67. DISCIPLINE

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP. ID
DAY/NIGHT CAMERA SYSTEM	DNCS	
(TITLE CONT.)	4. RESUME DATE	5. VER. #
	11/10/69	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
MOODY, J.C.	GODDARD SPACE FLT CENTER	301-982-6908
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
				08/68	POST FLIGHT

18. MONITOR	19. AGENCY	20. POST OFFICE	21. TELEPHONE
BURKE, J.R.	NASA HDQTRS	OSSA/SCS	202-962-0581

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
RCA ASTRO-ELECTRONICS	PRINCETON, NEW JERSEY	08/68	NA

26. INSTRUMENT TYPE	27. ACRONYM
IMAGER, 2-INCH VISIBLE IMAGE-ORTHICON	UNC

28. APPLICATION	29. SPACECRAFT
MET	ATS 4

30. PURPOSE

PRIMARY - TO EXTEND VIEWING OF EARTH'S CLOUD COVER ON A REGULAR BASIS TO INCLUDE NIGHT TIME IMAGING; TO EXAMINE OVERALL FEASIBILITY OF A HIGH RESOLUTION CONTINUOUS SURVEILLANCE CAMERA SYSTEM OPERATING FROM SYNCHRONOUS ALTITUDE.

31. PRINCIPLES OF OPERATION

THE INCOMING LIGHT IS REFLECTED FROM THE PRIMARY MIRROR, COLLECTED AT THE OBJECTIVE LENS AND PASSED THROUGH A BEAM-SPLITTER. IT IS THEN SIMULTANEOUSLY INCIDENT ON A PHOTOMULTIPLIER TUBE (PMT) AND THE IMAGE ORTHICON TUBE. A RETRACTABLE SUNSHADE IS AVAILABLE TO PREVENT STRAY LIGHT FROM ENTERING THE CAMERA'S FIELD OF VIEW WHILE IMAGING NIGHTTIME SCENES. THE IMAGE ORTHICON SATURATES UNDER NOMINAL FULL MOON CONDITIONS. WHEN THE SCENE ILLUMINATION IS ABOVE THIS LEVEL, ATTENUATION, IN THE FORM OF TWO TAPERED, DOUBLE CYCLE, COUNTER ROTATING NEUTRAL DENSITY FILTERS, IS INTRODUCED INTO THE OPTICAL PATH. THE PMT GENERATES A SIGNAL PROPORTIONAL TO THE AVERAGE SCENE ILLUMINATION OVER THE AREA VIEWED BY THE CAMERA. THE SIGNAL FROM THE PMT FEEDS AN AUTOMATIC LIGHT CONTROL CIRCUIT WHICH VARIES THE FILTERS UNTIL THE PMT SIGNAL REACHES THE DESIRED VALUE. THE OPTICS ARE STEERABLE BY MEANS OF GROUND COMMAND. STEPS OF 0.1 DEG THROUGH AN ANGLE OF PLUS-MINUS 12.5 DEG IN BOTH PITCH AND ROLL ARE POSSIBLE. THUS THE CAMERA IS ABLE TO TRACK AREAS OF METEOROLOGICAL INTEREST KNOWING THE SPACECRAFT ATTITUDE AND THE LOCATION OF THE DESIRED VIEWING AREA. FULL EARTH COVERAGE CAN BE ACHIEVED BY TAKING A SERIES OF OVERLAPPING PICTURES.

32. PHENOMENA OBSERVED

VISIBLE LIGHT REFLECTED FROM EARTH AND CLOUD COVER

33. MEASUREMENT RANGE

0.0001 TO .10000 FOOT-LAMBERTS

34. PRECISION AND ACCURACY

800 LINES HORIZONTAL RESOLUTION, 620 LINES VERTICAL RESOLUTION

35. SPECTRAL RANGE			36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.3	TO 0.7	MICRON	NA	450.0 MILLSEC

38. FIELD OF VIEW	39. GROUND SWATH
4.1K DEG	LIMB-TO-LIMB (1700 NM) FROM GEO-SYNCH ALT

40. IFOV	41. SPATIAL RESOLUTION
0.005 DEG	2.16 NM AT CENTER

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
0.2	DEG/SEC	SYNCH CIRCULAR	EQUATORIAL POSIGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

IMAGE ORTHICON, OPTICS, SUNSHADE

48. WEIGHT & VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
56 LB	21 WATTS		48 WATTS	

54. INTERFACE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING

59. DATA RATE	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
GRAY-SCALE CALIBRATOR	REALTIME TELEMETRY	CONTINUOUS

62. TELEMETRY REQUIREMENTS

60 KHZ VIDEO BANDWIDTH

63. ADVANTAGES AND LIMITATIONS

NIGHT-TIME IMAGING.

64. REFERENCES

1) OSTROW, H. AND WEINSTEIN, O.: A REVIEW OF A DECADE OF SPACE CAMERA SYSTEMS DEVELOPEMNT FOR METEOROLOGY; PRESENTED AT SOCIETY OF PHOTO-OPTICAL INSTRUMENTATION ENGINEERS 13TH ANNUAL TECHNICAL SYMPOSIUM, AUG. 1968.***2) SHAW, D.B.: THE IMAGE ORTHICON CAMERA. PRESENTED AT ATS SYSTEMS ENGINEERS TRAINING PROGRAM, GSFC, SEPT. 1966.

65. HISTORICAL REMARKS

SPACECRAFT FAILED TO REACH SYNCHRONOUS ORBIT

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
MICROWAVE TRANSPONDER	MTRAN	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
DARCEY, R.J.	GODDARD SPACE FLT CENTER	301-982-4094
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
				08/68	POST FLIGHT

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
BURKE, J.R.	NASA HDQTRS	OSSA/SCS	202-962-0581

22 VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
HUGHES AIRCRAFT CO	EL SEGUNDO, CALIFORNIA	08/68	NA

26. INSTRUMENT TYPE	27. SECURITY
TRANSPONDER, 6-GHZ (RECEIVE) 4-GHZ (TRANSMIT) SHF	UNC

28. APPLICATION	29. SPACECRAFT
COMM	ATS 4

30. PURPOSE

PRIMARY-TO DETERMINE THE USEFULNESS OF SHF AS A WIDEBAND TRANSMISSION MEDIUM, ESPECIALLY TO EVALUATE THE TRANSMISSION OF MONOCHROME AND COLOR TELEVISION AND THE SIMULTANEOUS TRANSMISSION OF MANY VOICE, TELETYPE AND DATA CHANNELS FROM SEVERAL GROUND STATIONS.***SECONDARY-TO DETERMINE AND EVALUATE THE PHENOMENA AFFECTING WIDEBAND SHF TRANSMISSIONS.

31. PRINCIPLES OF OPERATION

THE SYSTEM CONSISTS OF TWO PLANAR ARRAY ANTENNAS--ONE TO RECEIVE AT EITHER 6.212 OR 6.301 GHZ AND ONE TO TRANSMIT AT 4.120 OR 1.550 GHZ--AND TWO TRANSPONDERS EACH CONTAINING TWO TRAVELING WAVE TUBE (TWT) AMPLIFIERS THAT CAN OPERATE SINGLY OR IN PARALLEL. THE 4.120 GHZ SYSTEM CONTAINS TWO 4 W TWT'S, AND THE 1.550 GHZ SYSTEM CONTAINS TWO 12.5 W TWT'S. EACH ANTENNA HAS A HALF-BEAMWIDTH OF 23 DEG AND A GAIN OF 16.5 DB. USING THE 8 W TRANSMITTER AND INCLUDING LOSSES, THE EFFECTIVE RADIATED POWER IS 23.7 DBW (234 W). THE TRANSPONDERS CAN BE USED IN EITHER OF TWO MODES: A MULTIPLE ACCESS (MA) MODE OR A SIMPLE FREQUENCY TRANSLATION (FT) MODE. WITH A BANDWIDTH OF 4.5 MHZ, THE MA MODE SIMULTANEOUSLY RELAYS, BETWEEN SEVERAL GROUND STATIONS, UP TO 1200 3.1 KHZ WIDE VOICE, DATA OR TELETYPE CHANNELS USING SSB ON THE UPLINK AND PHASE MODULATION (PM) ON THE DOWNLINK. THE FT MODE, USING FM/FM SIGNALS, HAS A BANDWIDTH OF 25 MHZ AND IS USED PRIMARILY TO EVALUATE RELAYS OF MONOCHROME OR COLOR TELEVISION BROADCASTS. THIS MODE CAN ALSO BE USED IN A SECOND FREQUENCY DIVISION MULTIPLEXING SYSTEM TO HANDLE UP TO 1200 CHANNELS OF VOICE OR DATA. THE MODE USED IS SELECTED FROM THE GROUND. AN OMNIDIRECTIONAL ANTENNA IS USED WHILE S/C SPINS.

32. PHENOMENA OBSERVED

TRANSMISSIONS FROM ATS GROUND STATIONS AT 6 GHZ

33. MEASUREMENT RANGE

34. PRECISION AND ACCURACY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
6.212 AND 6.301 GHZ	30. MHZ	

38. FIELD OF VIEW	39. GROUND SWATH
18.0 BY 23.0 DEG	LIMB-TO-LIMB (9700 NM) FROM GEO-SYNCH ALT

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED ECCENTRIC	MEDIUM POSIGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

TRANSPONDER, TWO ANTENNAS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
		20 WATTS			5 YEAR

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
SOURC/SEN			SENSITIVE	

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
NA	REALTIME TELEMETRY	CONTINUOUS

62. TELEMETRY REQUIREMENTS

NA

63. ADVANTAGES AND LIMITATIONS

SECOND STAGE FAILURE ON ATS 4 PREVENTED SPACECRAFT FROM REACHING SYNCHRONOUS ORBIT.

64. REFERENCES

1) NASA PRESS KIT, ATS D, RELEASE NO. 68-127, JULY 21,1968.***2) PROJECT DEVELOPMENT PLAN-APPLICATIONS TECHNOLOGY SATELLITE, GSFC GREENBELT, MD.***3) TECHNICAL DATA REPORT FOR THE ATS PROGRAM, SEC. 7, GSFC, 1968.

65. HISTORICAL REMARKS

SIMILAR SYSTEMS ON ATS 1, 2 AND 3; IDENTICAL ON ATS 5

66. DIAGRAM

ATS 5

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
MICROWAVE TRANSPONDER	MTRAN	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
DARCEY, R.J.	GODDARD SPACE FLIGHT CTR	301-982-4094
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
				08/69	OPERATIONAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
BURKE, J.R.	NASA HDQTRS	OSSA/SCS	202-962-0581

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
HUGHES AIRCRAFT CO	EL SEGUNDO, CALIFORNIA	08/69	NA

26. INSTRUMENT TYPE	// SECURITY
TRANSPONDER, 6-GHZ (RECEIVE) 4-GHZ (TRANSMIT) SHF	UNC

28. APPLICATION	29. SPACECRAFT
COMM	ATS 5

30. PURPOSE

PRIMARY-TO DETERMINE THE USEFULNESS OF SHF AS A WIDEBAND TRANSMISSION MEDIUM, ESPECIALLY TO EVALUATE THE TRANSMISSION OF MONOCHROME AND COLOR TELEVISION AND THE SIMULTANEOUS TRANSMISSION OF MANY VOICE, TELETYPE AND DATA CHANNELS FROM SEVERAL GROUND STATIONS.***SECONDARY-TO DETERMINE AND EVALUATE THE PHENOMENA AFFECTING WIDEBAND SHF TRANSMISSIONS.

31. PRINCIPLES OF OPERATION

THE SYSTEM CONSISTS OF TWO PLANAR ARRAY ANTENNAS--ONE TO RECEIVE AT EITHER 6.212 OR 6.301 GHZ AND ONE TO TRANSMIT AT 4.120 OR 1.550 GHZ--AND TWO TRANSPONDERS EACH CONTAINING TWO TRAVELING WAVE TUBE (TWT) AMPLIFIERS THAT CAN OPERATE SINGLY OR IN PARALLEL. THE 4.120 GHZ SYSTEM CONTAINS TWO 4 W TWT'S, AND THE 1.550 GHZ SYSTEM CONTAINS TWO 12.5 W TWT'S. EACH ANTENNA HAS A HALF-BEAMWIDTH OF 23 DEG AND A GAIN OF 16.5 DB. USING THE 8 W TRANSMITTER AND INCLUDING LOSSES, THE EFFECTIVE RADIATED POWER IS 23.7 DBW (234 W). THE TRANSPONDERS CAN BE USED IN EITHER OF TWO MODES: A MULTIPLE ACCESS (MA) MODE OR A SIMPLE FREQUENCY TRANSLATION (FT) MODE. WITH A BANDWIDTH OF 4.5 MHZ, THE MA MODE SIMULTANEOUSLY RELAYS, BETWEEN SEVERAL GROUND STATIONS, UP TO 1200 3.1 KHZ WIDE VOICE, DATA OR TELETYPE CHANNELS USING SSB ON THE UPLINK AND PHASE MODULATION (PM) ON THE DOWNLINK. THE FT MODE, USING FM/PM SIGNALS, HAS A BANDWIDTH OF 25 MHZ AND IS USED PRIMARILY TO EVALUATE RELAYS OF MONOCHROME OR COLOR TELEVISION BROADCASTS. THIS MODE CAN ALSO BE USED IN A SECOND FREQUENCY DIVISION MULTIPLEXING SYSTEM TO HANDLE UP TO 1200 CHANNELS OF VOICE OR DATA. THE MODE USED IS SELECTED FROM THE GROUND. AN OMNIDIRECTIONAL ANTENNA IS USED WHILE S/C SPINS.

32. PHENOMENA OBSERVED

TRANSMISSIONS FROM ATS GROUND STATIONS AT 6 GHZ

33. MEASUREMENT RANGE

34. PRECISION AND ACCURACY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
6.212 AND 6.301 GHZ	25. MHZ	

38. FIELD OF VIEW	39. GROUND SWATH
18.0 BY 23.0 DEG	LIMB-TO-LIMB 9700 NM FROM GEO-SYNCH ALT

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		SYNCH CIRCULAR	EQUATORIAL POSIGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

TRANSPONDER, TWO ANTENNAS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
		20 WATTS			50 KHR

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
SOURC/SEN			SENSITIVE	

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
NA	REALTIME TELEMETRY	CONTINUOUS

62. TELEMETRY REQUIREMENTS

NA

63. ADVANTAGES AND LIMITATIONS

64. REFERENCES

1) NASA PRESS KIT, ATS-D, RELEASE NO. 68-127, JULY 21, 1968.***2) PROJECT DEVELOPMENT PLAN-APPLICATIONS TECHNOLOGY SATELLITE, GSFC, GREENBELT, MD.***3) TECHNICAL DATA REPORT FOR THE ATS PROGRAM, SEC. 7, GSFC, 1968.

65. HISTORICAL REMARKS

SIMILAR SYSTEMS ON ATS 1, 2 AND 3; IDENTICAL ON ATS 4

66. DIAGRAMS

ERTS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
RETURN-BEAM VIDICON CAMERA SYSTEM	RBV	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
WEINSTEIN, O.	GODDARD SPACE FLT CENTER	301-982-4108
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
RAGLAND, T.	GODDARD SPACE FLT CENTER	301-982-2493

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
CPIF	NAS5-11621		10/68		ADVAN DSGN

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GEORGE, T.	NASA HDQTRS	OSSA/SRB	202-963-5039

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
RCA ASTRO-ELECTRONICS	PRINCETON, N.J.	01/72	

26. INSTRUMENT TYPE	27. SECURITY
IMAGER, 2-INCH HIGH-RESOLUTION RETURN-BEAM-VIDICON	UNC

28. APPLICATION	29. SPACECRAFT
ERSP, MET	ERTS

30. PURPOSE

PRIMARY-TO PROVIDE CONTINUOUS, OVERLAPPING MULTI-SPECTRAL PHOTOGRAPHIC COVERAGE OF THE EARTH'S SURFACE ALONG THE ORBITAL TRACK AND REPEATED OBSERVATIONS OF ANY GIVEN AREA WITHIN THE MINIMUM TIME INTERVAL POSSIBLE.

31. PRINCIPLES OF OPERATION

THE RBVC, AS PROPOSED, IS A 3 CAMERA SYSTEM SPANNING THE VISIBLE SPECTRUM IN 3 BANDS; .475-.575, .580-.680, AND .690-.830 MICRON. SPECTRAL BANDS ARE OBTAINED THROUGH USE OF FILTERS IN ACQUISITION OPTICS. AN ELECTRONICALLY TRIGGERED, VARIABLE-SPEED, FOCAL-PLANE SHUTTER ALLOWS PICTURE-TAKING OVER A WIDE RANGE OF SCENE BRIGHTNESS AND PROVIDES UNIFORM EXPOSURE OF THE VIDICON. THIS SENSOR, A 2-INCH RETURN BEAM VIDICON, COMBINES THE VIDICON AND ORTHICON TUBE. THE VIDEO OUTPUT IS DERIVED FROM THE RETURN SCANNING BEAM. A PHOTOCONDUCTIVE SURFACE CHARGES THE TARGET SURFACE IN PROPORTION TO THE LIGHT RECEIVED. THEN AS THE ELECTRON SCANNING BEAM TRAVERSES THE TARGET, THE CHARGE MODULATES THIS BEAM WHICH IS THEN AMPLIFIED BY AN ELECTRON MULTIPLIER. THE VIDEO OUTPUT OF THE SYSTEM MAY BE FED DIRECTLY TO THE MODULATOR OF THE SPACECRAFT COMMUNICATION SYSTEM. THE CAMERAS ARE POINTED AT NADIR AND A NEW SCENE IS IMAGED ON THE PHOTO CONDUCTOR SURFACES EVERY 25 SEC. THE RESOLUTION CAPABILITY OF THE SYSTEM IS 4500 TV LINES. EQUIPPED WITH A 130 MM FL, F/2.8 LENS, EACH FRAME WILL COVER AN AREA OF 100 X 100 NM AT A RESOLUTION OF ABOUT 150 FEET PER TV LINE FROM 496 NM ALTITUDE. THE SENSOR IS CAPABLE OF RESOLVING 90 LINE-PAIRS/MILLIMETER.

32. PHENOMENA OBSERVED

RADIATION FROM THE SURFACE OF THE EARTH IN THE VISIBLE SPECTRUM

33. MEASUREMENT RANGE

DYNAMIC RANGE= 100 AT 0.1 MICROWATT-SEC/SQ-CM; 13 GRAY LEVELS

34. PRECISION AND ACCURACY

SIN= 35 DB AT 0.1 MICROWATT-SEC/SQ-CM W/O APERTURE CORRECTION

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.475 TO 0.830 MICRON	NA	

38. FIELD OF VIEW	39. GROUND SWATH
11.5 BY 11.5 DEG	100 NM BY 100 NM FROM 500 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.002 DEG	100 FEET PER TV-LINE FROM 500 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED CIRCULAR	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

3 RBV CAMERAS (CAMERA HEAD + ELECTRONICS), RECORDER, TRANSMITTER

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
130 LB	3.0 CU FT	130 WATTS	66 WATTS	145 WATTS	12 MON

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
SENSITIVE				MAGNETIC SHIELDING USED

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
NO IN-FLIGHT CALIBRATION	DELAYED TELEMETRY	ON COMMAND

62. TELEMETRY REQUIREMENTS

1 MINUTE PER ORBIT BASED ON AVERAGE OF 14 ORBITS PER DAY

63. ADVANTAGES AND LIMITATIONS

HIGH RESOLUTION MULTI-SPECTRAL PHOTOGRAPHY WITH 1 YEAR OPERATIONAL CAPABILITY

64. REFERENCES

1) RCA ASTRO-ELECTRONICS DIV. TECHNICAL REPORTS, 1968.

65. HISTORICAL REMARKS

66. DIAGRAMS

ESSA 1

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
VIDICON CAMERA SYSTEM	VCSW	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
WIDE-ANGLE	11/10/69	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
O'BRIEN, J.J. (T.MON)	GODDARD SPACE FLT CENTER	301-982-5716
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					POST FLIGHT

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GLOVER, J. C.	NESC (ESSA)		301-440-7543

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
RCA ASTRO-ELECTRONICS	PRINCETON, N. J.	02/66	

26. INSTRUMENT TYPE — 27. SECURITY

IMAGER, 0.5-INCH WIDE-ANGLE F/1.5 LOW-RESOLUTION VIDICON

28. APPLICATION	29. SPACECRAFT
MET	ESSA 1

30. PURPOSE

PRIMARY-TO ACQUIRE AND TRANSMIT PICTURES OF THE EARTH'S CLOUD COVER TO PROVIDE METEOROLOGISTS WITH DETAILED INFORMATION ON INDIVIDUAL CLOUD TYPES OVER SPECIFIC AREAS. THE FIRST SATELLITE IN THE TIROS OPERATIONAL SATELLITE (TOS) SYSTEM.

31. PRINCIPLES OF OPERATION

THE ESSA 1 WIDE ANGLE TV CAMERA WAS IDENTICAL TO THOSE CARRIED ON ALL PREVIOUS MISSIONS. HOWEVER, THIS FLIGHT CARRIED TWO IDENTICAL CAMERAS MOUNTED DIAMETRICALLY OPPOSITE TO EACH OTHER AND CANTED 2L DEG AWAY FROM THE PLANE OF ROTATION OF THE SPACECRAFT; THIS IS THE TIROS 9 CARTWHEEL CONFIGURATION. EACH CAMERA IS AUTOMATICALLY TRIGGERED SO AS TO BE IN A PICTURE TAKING MODE ONLY WHEN VIEWING THE EARTH, ONCE EACH SPACECRAFT ROTATION (10 RPM). EACH CAMERA CONSISTS OF A 1/2-IN VIDICON TUBE AND A FOCAL-PLANE SHUTTER THAT PERMITS STORAGE OF STILL PICTURES ON THE TUBE SCREEN. AN ELECTRON BEAM CONVERTS THE STORED PICTURES INTO TV-TYPE ELECTRONIC SIGNALS, WHICH CAN ALSO PROCESS AND STORE UP TO 32 PICTURES ON MAGNETIC TAPE FOR LATER TRANSMISSION. THE CAMERA HAS A WIDE ANGLE (105 DEG) ELGEET F/1.5 LENS. THE CAMERA HAS A SHUTTER SPEED OF 1.5 MILLISEC AND A VIDEO-BANDWIDTH OF 62.5 KHZ. THE 500 LINE FRAME IS PROCESSED FOR STORAGE IN 2 SECS. A MINIMUM INTERVAL OF 10 SEC BETWEEN PICTURES IS REQUIRED FOR THE TARGET IMAGE TO BE ELECTRICALLY ERASED. TRANSMISSION OF THE REEL OF 32 PICTURES CAN BE ACCOMPLISHED IN 100 SEC BY A 2-WATT FM TRANSMITTER OPERATING AT A FREQUENCY OF 235 MHZ.

32. PHENOMENA OBSERVED

CLOUD COVER AND THE EARTH'S SURFACE

33. MEASUREMENT RANGE

5 LEVELS OF GRAY

34. PRECISION AND ACCURACY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.4 TO 0.65 MICRON	NA	

38. FIELD OF VIEW	39. GROUND SWATH
74.0 BY 74.0 DEG	650 NM BY 650 NM FROM 400 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.2 DEG	1.4 NM PER TV LINE FROM 400 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED CIRCULAR	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

TV CAMERA, TRANSMITTER, TAPE RECORDER

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
		9 WATTS		9 WATTS	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
	SENSITIVE			MAGNETIC SHIELDING USED

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
NO IN-FLIGHT CALIBRATION	DELAYED TELEMETRY	DAYSIDE OF ORBIT

62. TELEMETRY REQUIREMENTS

FULL REEL OF 32 PICTURES CAN BE READ OUT IN 100 SECONDS USING AN FM TRANSMITTER OPERATING AT A FREQUENCY OF 235 MHZ.

63. ADVANTAGES AND LIMITATIONS

BROAD SYNOPTIC VIEWING OF CLOUD COVER PATTERNS. MORE VALUABLE DATA FOR WEATHER ANALYSIS THAN FROM MED. OR NARROW ANGLE CAMERAS

64. REFERENCES

1) SIGNIFICANT ACHIEVEMENTS IN SAT MET 1958-1964. NASA SP-96.*** 2) GOLDBERG, E.A. AND LANDON, V.D.: KEY EQUIP FOR TIROS 1. ASTRONAUTICS, V.5, JUNE 1960.***3) MESNER, M.H. AND STANISZEWSKI, J.: TV CAMERAS FOR SPACE EXPLOR. ASTRONAUTICS, V.5, MAY 1960.*** 4) INSTRUMENTS AND SPACECRAFT. NASA SP-3028, 1966. ***5) DATA AVAILABLE FROM NATIONAL WEATHER RECORDS CTR (ESSA), ASHEVILLE, NC.

65. HISTORICAL REMARKS

66. DIAGRAMS

ESSA 2

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
AUTOMATIC PICTURE-TRANSMISSION SYSTEM	APT	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0006

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
O'BRIEN, J.J. (T.MON)	GODDARD SPACE FLT CENTER	301-982-5716
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					POST FLIGHT

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GLOVER, J.C.	NESC/ESSA		

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
RCA ASTRO-ELECTRONICS	PRINCETON, NEW JERSEY	02/66	NA

26. INSTRUMENT TYPE	27. SECURITY
IMAGER, 1-INCH AUTOMATIC-PICTURE-TRANSMISSION VIDICON	UNC

28. APPLICATION	29. SPACECRAFT
MET	ESSA 2

30. PURPOSE

PRIMARY-TO PROVIDE METEOROLOGISTS WITH REALTIME INFORMATION ON CLOUD AND WEATHER CONDITIONS OVER A LARGE AREA AROUND THE RECEIVING STATION***SECONDARY-MAINTAIN CAPABILITY OF THE TOS-ESSA SATELLITE SYSTEM.

31. PRINCIPLES OF OPERATION

THIS SYSTEM, CONSISTING OF 2-IDENTICAL 1-INCH VIDICON APT CAMERAS, WAS ALSO TEST FLOWN ON TIROS 8 AND NIMBUS 1 AND 2 AND OPERATIONALLY FLOWN ON ESSA 4 AND 6. EACH CAMERA UTILIZES A TEGEA-KINOPTIC, 108-DEGREE, WIDE ANGLE, F/1.8 OBJECTIVE LENS WITH A FOCAL LENGTH OF 5.7 MM. THE TWO CAMERAS ARE MOUNTED 180 DEGREES APART ON THE SIDE OF THE SPACECRAFT AND PERPENDICULAR TO THE SPIN AXIS, SO THEY POINT DIRECTLY DOWNWARD ONCE EVERY 5.5 SECS, DURING WHICH TIME PICTURES ARE TAKEN. THE SYSTEM IS PROGRAMMED TO TAKE AND TRANSMIT A PICTURE EVERY 350 SECS, FOR A TOTAL SEQUENCE OF 8 PICTURES, WHILE THE SATELLITE IS IN DAYLIGHT. THE ACTUAL PICTURE TAKING REQUIRES 8 SECS AND THE TRANSMISSION 200 SECS. DURING THIS LATTER PERIOD THE VIDICON IS SCANNED AT FOUR LINES PER SECOND, AND THE SIGNALS TRANSMITTED PRODUCING AN CAMERA HAS A SHUTTER SPEED OF 1.5 MILLSEC AND A VIDEO-BANDWIDTH TRACK. THE SHUTTER UTILIZED IS A MODIFIED TIROS TYPE-F, FULL-SCAN, FOCAL-PLANE SHUTTER ADJUSTED FOR A 1.5-MSEC EXPOSURE. TWO 5-WATT TV TRANSMITTERS ARE USED, EACH PROVIDING A 137.5 MHZ CARRIER. AN APT GROUND STATION WITH AN APPROPRIATE ANTENNA, RECEIVER, AND A RECORDER CAN RECEIVE THESE PICTURES WHEN THE SPACECRAFT IS WITHIN ACQUISITION RANGE.

32. PHENOMENA OBSERVED

CLOUD AND TERRAIN FEATURES OF APPROX 2 NM OR LARGER

33. MEASUREMENT RANGE

DYNAMIC PICTURE RANGE OF 25:1

34. PRECISION AND ACCURACY

S/N OF 30 DB AT 0.7 FOOT CANDLES/SEC; 10 LEVELS OF GRAY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.45 TO 0.65 MICRON	NA	

38. FIELD OF VIEW	39. GROUND SWATH
89.0 BY 89.0 DEG	1800 NM BY 1800 NM FROM 750 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.132 DEG	1.7 NM FROM 750 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED CIRCULAR	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

2 VIDICON CAMERAS, 2 ELECTRONICS MODULES, 2 FM TRANSMITTERS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
22 LB		28 WATTS		40 WATTS	

54. AF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
SENSITIVE	SENSITIVE			MAGNETIC SHIELDING USED

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
	REALTIME TELEMETRY	CONTINUOUS DAYTIME

62. TELEMETRY REQUIREMENTS

THE VIDEO OUTPUT, TURN-ON, AND PHASING CODE DRIVE A MODULATOR WHICH AMPLITUDE MODULATES THE 2400 HZ SUBCARRIER, THUS REQUIRING 4000 HZ MAXIMUM FREQUENCY CAPABILITY.

63. ADVANTAGES AND LIMITATIONS

DIRECT TRANSMISSION TO MANY GROUND STATIONS WITHOUT INTERMEDIATE STORAGE ON MAGNETIC TAPE.

64. REFERENCES

1) APT USERS GUIDE. ESSA, NAT WEATHER SAT CTR, 1965.***2) STAMPFL, R.A. AND STROUD, W.G.: THE APT TV CAMERA SYSTEM FOR MET SATS. NASA/GSFC TN D-1915, NOV. 1963.***3) FINAL ENGINEERING REPORT, TOS/OT-2. RCA CORP. MAY 1967.***4) SIG ACHIEV IN SPACE APP. 1966 NASA SP-156.***5) OSTROW, H. AND WEINSTEIN, O.: REVIEW OF A DECADE OF SPACE CAMERA SYSTEMS DEVELOPMENT FOR MET. GSFC, 1968.

65. HISTORICAL REMARKS

SIMILAR TO APT ON TIROS 8, NIMBUS 1 AND 2, AND ESSA 4 AND 6.

66. DIAGRAMS

ESSA 3

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
ADVANCED VIDICON CAMERA SYSTEM	AVCS	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
O'BRIEN,J.J.(T.MON)	GODDARD SPACE FLT CENTER	301-982-5716
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					POST FLIGHT

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GLOVER, J.C.	NESC (ESSA)		

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
RCA ASTRO-ELECTRONICS	PRINCETON, N.J.	10/66	NA

26. INSTRUMENT TYPE	27. SECURITY
IMAGER, 1-INCH WIDE-ANGLE HIGH-RESOLUTION VIDICON	UNC

28. APPLICATION	29. SPACECRAFT
MET, ERSP	ESSA 3

30. PURPOSE

PRIMARY-TO PROVIDE METEOROLOGICAL DATA IN THE FORM OF WIDE-ANGLE HIGH-RESOLUTION TELEVISION PICTURES OF EARTH'S CLOUD COVER, BY TRANSMITTING PRERECORDED TV PICTURES TO CDA STATIONS.***SECONDARY-MAINTAIN OPERATIONAL CAPABILITY OF THE AVCS.

31. PRINCIPLES OF OPERATION

THE AVCS, TEST FLOWN ON NIMBUS 1 AND 2 AND OPERATIONALLY ON ESSA 3 AND 5, ARE SIMILAR EXCEPT FOR DIFFERENT CAMERA LENSES AND ESSA HAVING 2 CAMERAS WHILE NIMBUS HAD 3. THE ESSA SYSTEM CONSISTS OF 2 IDENTICAL 1-INCH VIDICONS HAVING 800 TV LINE RESOLUTION. THE CAMERAS ARE MOUNTED 180 DEGREES APART ON THE SIDE OF THE SPACECRAFT AND PERPENDICULAR TO THE SPIN AXIS. DURING PICTURE TAKING SEQUENCE THE CAMERA LOOKS AT THE NADIR. THE LENS IS A TEGEA KINOPTIC 108 DEGREE WIDE ANGLE LENS WITH A FOCAL LENGTH OF 5.7 MM AND AN ELECTROMAGNETICALLY CONTROLLED SHUTTER. THE CAMERA CONVERTS THE OPTICAL IMAGE TO AN ELECTRICAL SIGNAL WHICH IS PROCESSED AND RECORDED ON A MAGNETIC TAPE RECORDER. THE VIDICON HAS AN INHERENT STORAGE PROPERTY WHICH PERMITS A NOMINAL 6.5 SECOND FRAME TIME. CONCURRENTLY WITH SHUTTER ACTUATION, A 16-INCREMENT GRAY SCALE IS INCLUDED AT THE EDGE OF EACH PICTURE FRAME AS A CONTRAST CHECK. THE CAMERA IS INDEPENDENTLY TRIGGERED INTO OPERATION ONLY WHEN IT COMES IN VIEW OF THE EARTH; THIS IS DONE BY A HORIZON CROSSING INDICATOR(HCI), ONE FOR EACH CAMERA. THE CAMERA CAN TAKE 6 OR 12 CLOUD COVER PICTURES PER ORBIT AT 260-SECOND INTERVALS WITH A 50 PERCENT OVERLAP.

32. PHENOMENA OBSERVED

CLOUD COVER OF EARTH (REFLECTED VISIBLE SOLAR RADIATION)

33. MEASUREMENT RANGE

DYNAMIC RANGE OF 14 TO 11,400 FOOT-LAMBERTS

34. PRECISION AND ACCURACY

800 TV-LINE RESOLUTION; 16 LEVELS OF GRAY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.45 TO 0.65 MICRON	NA	

38. FIELD OF VIEW	39. GROUND SWATH
89.0 BY 89.0 DEG	1700 NM BY 1700 NM FROM 750 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.11 DEG	1.4 NM PER TV-LINE AT THE NADIR FROM 750 NM ALT

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
0.5 DEG		MED CIRCULAR	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

2 TV CAMERA SYSTEMS, 2 TAPE RECORDERS, SYSTEM ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
43 LB		16 WATT			

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
	SENSITIVE			MAGNETIC SHIELDING USED

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
GRAY-SCALE CALIBRATION	DELAYED TELEMETRY	DAYSIDE OF ORBIT

62. TELEMETRY REQUIREMENTS

RECORDER IS PLAYED BACK ON CDA STATION COMMAND VIA THE SPACECRAFT 235-MHZ TRANSMITTER. TRANSMISSION TIME FOR A FULL ORBIT OF PICTURES IS APPROXIMATELY 3 MINUTES.

63. ADVANTAGES AND LIMITATIONS

DUE TO CAMERA MOUNTING PICTURES ARE TAKEN STRAIGHT DOWN MINIMIZING DISTORTION AND INCREASING ACCURACY

64. REFERENCES

1) FINAL ENGINEERING REPORT TOS A,VOL 1,2,3.RCA ASTRO-ELECTRONICS CONTRACT NO. NAS 5-9034, MAY 5, 1967.***2) SIG ACHIEV IN SPACE APP 1966. NASA SP-156, 1967.***3) OSTROW,H.: REVIEW OF A DECADE OF SPACE CAMERA SYSTEMS DEVELOP. FOR METEOROLOGY. NASA/GSFC,AUG. 1968.***4) DATA AVAILABLE FROM NATIONAL WEATHER RECORDS CTR (ESSA), ASHEVILLE, N.C.

65. HISTORICAL REMARKS

SIMILAR TO AVCS ON NIMBUS 1 AND 2, AND ESSA 5.

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
LOW-RESOLUTION INFRARED RADIOMETER	LRIR	
, (TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
PARENT, DR. R.J.	UNIVERSITY OF WISCONSIN	608-262-5938
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					POST FLIGHT

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GLOVER, J.C.	NESC/ESSA		301-440-7543

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
UNIVERSITY OF WISCONSIN	MADISON, WISCONSIN	10/66	

26. INSTRUMENT TYPE	27. SECURITY
RADIOMETER, FLAT-PLATE IR/VISIBLE LOW-RESOLUTION	UNC

28. APPLICATION	29. SPACECRAFT
MET	ESSA 3

30. PURPOSE

PRIMARY-TO GATHER DATA TO AID IN DETERMINING: (1) THE GEOGRAPHIC DISTRIBUTION OF ENERGY RADIATED FROM THE EARTH AND THE RELATIONSHIP OF THIS ENERGY TO INCOMING ENERGY FROM THE SUN AND (2) THE REFLECTION AND SCATTERING OF SOLAR RADIATION BY THE EARTH-ATMOSPHERE SYSTEM.

31. PRINCIPLES OF OPERATION

THE ESSA FLAT PLATE RADIOMETER SYSTEM, IS DIVIDED INTO 2 BASIC COMPONENTS: A FLAT PLATE RADIOMETER WITH A 180 DEG FOV, AND A FLAT PLATE RADIOMETER EMPLOYING A CONE SHIELD TO MINIMIZE OR REMOVE ANY RESPONSE DUE TO DIRECT SOLAR RADIATION (70 DEG FOV). THE HEART OF EACH SENSOR IS A THIN ALUMINUM DISK THERMALLY AND RADIATIVELY ISOLATED FROM ITS MOUNTS. THE DISK TEMPERATURE IS SENSED BY 2 THERMISTORS MOUNTED ON THE BACK SURFACE OF THE DISK. THE HOUSING TEMPERATURES AND THE CONE TEMPERATURES ARE SEPARATELY SENSED AND RECORDED. TWO SPECTRAL RESPONSES ARE PROVIDED FOR THE DISKS BY THE USE OF ANODIZED ALUMINUM OR BLACK PAINT. THE BLACK PAINTED SURFACE WILL RESPOND TO THE SUM OF THE REFLECTED SOLAR, DIRECT SOLAR, AND RERADIATED LONG WAVE RADIATION. THE ANODIZED ALUMINUM SENSOR DISKS REFLECT IN THE VISIBLE RANGE BUT ABSORB IR RADIATION IN THE 7 TO 30 MICRON RANGE. THESE RESPOND TO THE RADIATED ENERGY FROM THE EARTH AND EXCLUDE TO A HIGH DEGREE THE DIRECT AND REFLECTED SOLAR RADIATION. BOTH DISK TYPES ARE USED WITH BOTH RADIOMETERS SO THAT 4 RADIOMETERS ARE NEEDED TO COMPLETE A SET. TWO SUCH SETS ARE MOUNTED 180 DEG APART ON THE S/C BUT ISOLATED THERMALLY AND RADIATIVELY FROM IT.

32. PHENOMENA OBSERVED

ENERGY RADIATED FROM AND REFLECTED BY THE EARTH/ATMOSPHERE

33. MEASUREMENT RANGE

34. PRECISION AND ACCURACY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.3 TO 30.0 MICRONS		

38. FIELD OF VIEW	39. GROUND SWATH
SEE ITEM 31	LIMB-TO-LIMB (4200 NM) FROM 750 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED CIRCULAR	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

8 SENSORS (THERMISTORS), ELECTRONICS, RECORDER

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
			SENSITIVE	FPR THERMALLY ISOLATED

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
	DELAYED TELEMETRY	CONTINUOUS

62. TELEMETRY REQUIREMENTS

90 KBITS TAPE CAPACITY.

63. ADVANTAGES AND LIMITATIONS

THE FPR DID NOT GET GOOD DATA STARTS HENCE TIME ERRORS OCCUR IN MOST READOUTS.

64. REFERENCES

1) FINAL ENGINEERING REPORT TOS A MET SAT SYSTEM, VOL 1. RCA ASTRO-ELECTRONICS, CONTRACT NO. NAS5-9034, MAY 5, 1967.***2) RUBIN, L.: OPERATIONAL PROCESSING OF LOW RESOLUTION IR (LRIR) DATA FROM ESSA SATELLITES. ESSA TECH REPORT NESC-42, FEB. 68.*** 3) ESSA NEWS RELEASE NO. ES 66-54, SEPT 19, 1968.***4) DATA AVAILABLE FROM NESC, ESSA, WASH. D.C.

65. HISTORICAL REMARKS

THIS RADIOMETER WILL ALSO FLY ON ITOS A, B, C, AND D.

66. DIAGRAMS

ESSA 4

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
AUTOMATIC PICTURE-TRANSMISSION SYSTEM	APT	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0006

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
O'BRIEN, J.J. (T. MON)	GODDARD SPACE FLT CENTER	301-982-5716
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					POST FLIGHT

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GLOVER, J.C.	NESC/ESSA		301-440-7543

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
RCA ASTRO-ELECTRONICS	PRINCETON, N.J.	01/67	NA

26. INSTRUMENT TYPE	27. SECURITY
IMAGER, 1-INCH AUTOMATIC-PICTURE-TRANSMISSION VIDICON	UNC

28. APPLICATION	29. SPACECRAFT
MET	ESSA 4

30. PURPOSE

PRIMARY-TO PROVIDE METEOROLOGISTS WITH REALTIME INFORMATION ON CLOUD AND WEATHER CONDITIONS OVER A LARGE AREA AROUND THE RECEIVING STATION.***SECONDARY-MAINTAIN CAPABILITY OF THE TOS-ESSA SATELLITE SYSTEM.

31. PRINCIPLES OF OPERATION

THIS SYSTEM, CONSISTING OF TWO IDENTICAL 1-INCH VIDICON APT CAMERAS, WAS ALSO TEST FLOWN ON TIROS 8 AND NIMBUS 1 AND 2 AND OPERATIONALLY FLOWN ON ESSA 2 AND 6. EACH CAMERA UTILIZES A TEGEA-KINOPTIC, 108-DEGREE, WIDE-ANGLE,F/1.8 OBJECTIVE LENS WITH A FOCAL LENGTH OF 5.7MM. THE TWO CAMERAS ARE MOUNTED 180 DEGREES APART ON THE SIDE OF THE SPACECRAFT AND PERPENDICULAR TO THE SPIN AXIS, SO THEY POINT DIRECTLY DOWNWARD ONCE EVERY 5.5 SECS, DURING WHICH TIME PICTURES ARE TAKEN. THE SYSTEM IS PROGRAMMED TO TAKE AND TRANSMIT A PICTURE EVERY 350 SECS FOR A TOTAL OF 8 PICTURES, WHILE THE SATELLITE IS IN DAYLIGHT. THE ACTUAL PICTURE TAKING REQUIRES 8 SECS AND THE TRANSMISSION 200 SECS. DURING THIS LATTER PERIOD THE VIDICON IS SCANNED AT FOUR LINES PER SECOND, AND THE SIGNALS TRANSMITTED PRODUCING AN 800-LINE PICTURE WITH SCAN LINES PERPENDICULAR TO THE ORBIT TRACK. THE SHUTTER UTILIZED IS A MODIFIED TIROS TYPE-F, FULL-SCAN, FOCAL-PLANE SHUTTER ADJUSTED FOR A 1.5-MSEC EXPOSURE. TWO 5-WATT TV TRANSMITTERS ARE USED, EACH PROVIDING A 137.5-MHZ CARRIER. AN APT GROUND STATION WITH AN APPROPRIATE ANTENNA, RECEIVER, AND A RECORDER CAN RECEIVE THESE PICTURES WHEN THE SPACECRAFT IS WITHIN ACQUISITION RANGE.

32. PHENOMENA OBSERVED

CLOUD AND TERRAIN FEATURES OF APPROX 2 NM OR LARGER

33. MEASUREMENT RANGE

DYNAMIC PICTURE RANGE 25:1

34. PRECISION AND ACCURACY

S/N OF 30 DB AT 0.7 FOOT-CANDLES/SEC; 10 LEVELS OF GRAY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.45 TO 0.65 MICRON	NA	

38. FIELD OF VIEW	39. GROUND SWATH
89.0 BY 89.0 DEG	1800 NM BY 1800 NM FROM 750 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.132 DEG	1.7 NM FROM 750 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED CIRCULAR	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

2 VIDICON CAMERAS, 2 ELECTRONICS MODULES, 2 FM TRANSMITTERS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
55 LB		28 WATTS		40 WATTS	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
SENSITIVE	SENSITIVE			MAGNETIC SHIELDING USED

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
	REALTIME TELEMETRY	CONTINUOUS DAYTIME

62. TELEMETRY REQUIREMENTS

THE VIDEO OUTPUT, TURN-ON, AND PHASING CODE DRIVE A MODULATOR WHICH AMPLITUDE MODULATES THE 2400 HZ SUBCARRIER, THUS REQUIRING 4000 HZ MAXIMUM FREQUENCY CAPABILITY.

63. ADVANTAGES AND LIMITATIONS

DIRECT TRANSMISSION TO MANY GROUND STATIONS WITHOUT INTERMEDIATE STORAGE ON MAGNETIC TAPE.

64. REFERENCES

1) APT USERS GUIDE. ESSA, NAT WEATHER SAT CTR, 1965.***2) STAMPFL, R.A. AND STROUD, W.G.: THE APT TV CAMERA SYSTEM FOR MET SATS. NASA/GSFC TN D-1915, NOV. 1963.***3) FINAL ENGINEERING REPORT, TOS/OT-2. RCA CORP. MAY 1967.***4) SIG ACHIEV IN SPACE APP. 1966 NASA SP-156.***5) OSTROW, H. AND WEINSTEIN, O.: REVIEW OF A DECADE OF SPACE CAMERA SYSTEMS DEVELOPMENT FOR MET. GSFC, 1968.

65. HISTORICAL REMARKS

SIMILAR TO APT ON TIROS 8, NIMBUS 1 AND 2, AND ESSA 2 AND 6.

66. DIAGRAMS

ESSA 5

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
ADVANCED VIDICON CAMERA SYSTEM	AVCS	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
O'BRIEN, J.J. (T.MON)	GODDARD SPACE FLT CENTER	301-982-5716
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					POST FLIGHT

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GLOVER, J.C.	NESC/ESSA		301-440-7543

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
RCA ASTRO-ELECTRONICS	PRINCETON, NEW JERSEY	04/67	NA

26. INSTRUMENT TYPE	27. SECURITY
IMAGER, 1-INCH WIDE-ANGLE HIGH-RESOLUTION VIDICON	UNC

28. APPLICATION	29. SPACECRAFT
MET, ERSP	ESSA 5

30. PURPOSE

PRIMARY-TO PROVIDE METEOROLOGICAL DATA IN THE FORM OF WIDE-ANGLE HIGH-RESOLUTION TELEVISION PICTURES OF EARTH'S COULD COVER, BY TRANSMITTING PRERECORDED TV PICTURES TO CDA STATIONS.***SECONDARY-MAINTAIN OPERATIONAL CAPABILITY OF THE AVCS.

31. PRINCIPLES OF OPERATION

THE AVCS, TEST FLOWN ON NIMBUS 1 AND 2 AND OPERATIONALLY ON ESSA 3 AND 5, ARE SIMILAR EXCEPT FOR DIFFERENT CAMERA LENSES AND ESSA HAVING 2 CAMERAS WHILE NIMBUS HAD 3. THE ESSA SYSTEM CONSISTS OF 2 IDENTICAL 1-INCH VIDICONS HAVING 800 TV LINE RESOLUTION. THE CAMERAS ARE MOUNTED 180 DEGREES APART ON THE SIDE OF THE SPACECRAFT AND PERPENDICULAR TO THE SPIN AXIS. DURING PICTURE TAKING SEQUENCE THE CAMERA LOOKS AT THE NADIR. THE LENS IS A TEGEA KINOPTIC 108 DEGREE WIDE ANGLE LENS WITH A FOCAL LENGTH OF 5.7 MM AND AN ELECTROMAGNETICALLY CONTROLLED SHUTTER. THE CAMERA CONVERTS THE OPTICAL IMAGE TO AN ELECTRICAL SIGNAL WHICH IS PROCESSED AND RECORDED ON A MAGNETIC TAPE RECORDER. THE VIDICON HAS AN INHERENT STORAGE PROPERTY WHICH PERMITS A NOMINAL 6.5 SECOND FRAME TIME. CONCURRENTLY WITH SHUTTER ACTUATION, A 16-INCREMENT GRAY SCALE IS INCLUDED AT THE EDGE OF EACH PICTURE FRAME AS A CONTRAST CHECK. THE CAMERA IS INDEPENDENTLY TRIGGERED INTO OPERATION ONLY WHEN IT COMES IN VIEW OF THE EARTH; THIS IS DONE BY A HORIZON CROSSING INDICATOR (HCI), ONE FOR EACH CAMERA. THE 4 TRACK MAGNETIC TAPE RECORDER CAN STORE UP TO 36 PICTURES. EACH CAMERA CAN TAKE 6 OR 12 CLOUD COVER PICTURES PER ORBIT AT 260-SECOND INTERVALS WITH A 50 PERCENT OVERLAP.

32. PHENOMENA OBSERVED

CLOUD COVER OF EARTH (REFLECTED VISIBLE SOLAR RADIATION)

33. MEASUREMENT RANGE

DYNAMIC RANGE OF 14 TO 11400 FOOT-LAMBERTS

34. PRECISION AND ACCURACY

800 TV-LINE RESOLUTION; 16 LEVELS OF GRAY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.45 TO 0.65 MICRON	NA	40.0 MILLSEC

38. FIELD OF VIEW	39. GROUND SWATH
89.0 BY 89.0 DEG	1700 NM BY 1700 NM FROM 750 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.11 DEG	1.4 NM PER TV-LINE AT CENTER FROM 750 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
0.5 DEG		MED CIRCULAR	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

2 TV CAMERA SYSTEMS, 2 TAPE RECORDERS, SYSTEM ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
43 LB		16 WATTS			

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
	SENSITIVE			MAGNETIC SHIELDING USED

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
GRAY-SCALE CALIBRATION	DELAYED TELEMETRY	DAYSIDE OF ORBIT

62. TELEMETRY REQUIREMENTS

RECORDER IS PLAYED BACK ON CDA STATION COMMAND VIA THE SPACECRAFT 235-MHZ TRANSMITTER. TRANSMISSION TIME FOR A FULL ORBIT OF PICTURES IS APPROXIMATELY 3 MINUTES.

63. ADVANTAGES AND LIMITATIONS

DUE TO CAMERA MOUNTING PICTURES ARE TAKEN STRAIGHT DOWN MINIMIZING DISTORTION AND INCREASING ACCURACY.

64. REFERENCES

1) FINAL ENGINEERING REPORT TOS A, VOL 1,2,3. RCA ASTRO-ELECTRONICS CONTRACT NO. NAS 5-9034, MAY 5, 1967.***2) SIG ACHIEV IN SPACE APP 1966. NASA SP-156, 1967.***3) OSTROW, H.: REVIEW OF A DECADE OF SPACE CAMERA SYSTEMS DEVELOP. FOR METEOROLOGY. NASA/GSFC, AUG. 1968.***4) DATA AVAILABLE FROM NATIONAL WEATHER RECORDS CTR (ESSA), ASHEVILLE, N.C.

65. HISTORICAL REMARKS

SIMILAR TO AVCS ON NIMBUS 1 AND 2, AND ESSA 3.

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
LOW-RESOLUTION INFRARED RADIOMETER	LRIR	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
PARENT, DR. R.J.	UNIVERSITY OF WISCONSIN	608-262-5938
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					POST FLIGHT

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GLOVER, J.C.	NESC/ESSA		301-440-7543

22. VENDOR	23. *LOCATION	24. FLIGHT DATE	25. LEAD TIME
UNIVERSITY OF WISCONSIN	MADISON, WISCONSIN	04/67	

26. INSTRUMENT TYPE	27. SECURITY
RADIOMETER, FLAT-PLATE IR/VISIBLE LOW-RESOLUTION	UNC

28. APPLICATION	29. SPACECRAFT
MET	ESSA 5

30. PURPOSE

PRIMARY-TO GATHER DATA TO AID IN DETERMINING: (1) THE GEOGRAPHIC DISTRIBUTION OF ENERGY RADIATED FROM THE EARTH AND THE RELATIONSHIP OF THIS ENERGY TO INCOMING ENERGY FROM THE SUN AND (2) THE REFLECTION AND SCATTERING OF SOLAR RADIATION BY THE EARTH-ATMOSPHERE SYSTEM.

31. PRINCIPLES OF OPERATION

THE ESSA FLAT PLATE RADIOMETER SYSTEM, IS DIVIDED INTO 2 BASIC COMPONENTS: A FLAT PLATE RADIOMETER WITH A 180 DEG FOV, AND A FLAT PLATE RADIOMETER EMPLOYING A CONE SHIELD TO MINIMIZE OR REMOVE ANY RESPONSE DUE TO DIRECT SOLAR RADIATION (70 DEG FOV). THE HEART OF EACH SENSOR IS A THIN ALUMINUM DISK THERMALLY AND RADIATIVELY ISOLATED FROM ITS MOUNTS. THE DISK TEMPERATURE IS SENSED BY 2 THERMISTORS MOUNTED ON THE BACK SURFACE OF THE DISK. THE HOUSING TEMPERATURES AND THE CONE TEMPERATURES ARE SEPARATELY SENSED AND RECORDED. TWO SPECTRAL RESPONSES ARE PROVIDED FOR THE DISKS BY THE USE OF ANODIZED ALUMINUM OR BLACK PAINT. THE BLACK PAINTED SURFACE WILL RESPOND TO THE SUM OF THE REFLECTED SOLAR, DIRECT SOLAR, AND RERADIATED LONG WAVE RADIATION. THE ANODIZED ALUMINUM SENSOR DISKS REFLECT IN THE VISIBLE RANGE BUT ABSORB IR RADIATION IN THE 7 TO 30 MICRON RANGE. THESE RESPOND TO THE RADIATED ENERGY FROM THE EARTH AND EXCLUDE TO A HIGH DEGREE THE DIRECT AND REFLECTED SOLAR RADIATION. BOTH DISK TYPES ARE USED WITH BOTH RADIOMETERS SO THAT 4 RADIOMETERS ARE NEEDED TO COMPLETE A SET. TWO SUCH SETS ARE MOUNTED 180 DEG APART ON THE S/C BUT ISOLATED THERMALLY AND RADIATIVELY FROM IT.

32. PHENOMENA OBSERVED

ENERGY RADIATED FROM AND REFLECTED BY THE EARTH/ATMOSPHERE

33. MEASUREMENT RANGE

34. PRECISION AND ACCURACY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.3 TO 30.0 MICRONS		

38. FIELD OF VIEW	39. GROUND SWATH
SEE ITEM 31	LIMB-TO-LIMB (4200 NM) FROM 750 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED CIRCULAR	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

8 SENSORS (THERMISTORS), ELECTRONICS, RECORDER

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
				SENSITIVE FPR THERMALLY ISOLATED

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
	DELAYED TELEMETRY	CONTINUOUS

62. TELEMETRY REQUIREMENTS

90 KBITS TAPE CAPACITY.

63. ADVANTAGES AND LIMITATIONS

THE FPR DID NOT GET GOOD DATA STARTS. THUS TIME ERRORS WERE INCURRED IN MOST READOUTS.

64. REFERENCES

1) FINAL ENGINEERING REPORT TOS A MET SAT SYSTEM, VOL 1. RCA ASTRO-ELECTRONICS, CONTRACT NO. NAS5-9034, MAY 5, 1967.***2) RUBIN, L.: OPERATIONAL PROCESSING OF LOW RESOLUTION IR (LRIR) DATA FROM ESSA SATELLITES. ESSA TECH REPORT NESC-42, FEB. 68.*** 3) ESSA NEWS RELEASE NO. ES 66-54, SEPT 19, 1968.***4) DATA AVAILABLE FROM NESC, ESSA, WASH. D.C.

65. HISTORICAL REMARKS

THIS RADIOMETER WILL ALSO FLY ON ITOS A, B, C, AND D.

66. DIAGRAMS

ESSA 6

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
AUTOMATIC PICTURE-TRANSMISSION SYSTEM	APT	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
O'BRIEN, J.J. (T. MON)	GODDARD SPACE FLT CENTER	301-982-5716
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					OPERATIONAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GLOVER, J.C.	NESC/ESSA		301-440-7543

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
RCA ASTRO-ELECTRONICS	PRINCETON, N.J.	11/67	NA

26. INSTRUMENT TYPE	27. SECURITY
IMAGER, 1-INCH AUTOMATIC-PICTURE-TRANSMISSION VIDICON	UNC

28. APPLICATION	29. SPACECRAFT
MET	ESSA 6

30. PURPOSE

PRIMARY-TO PROVIDE METEOROLOGISTS WITH REALTIME INFORMATION ON CLOUD AND WEATHER CONDITIONS OVER A LARGE AREA AROUND THE RECEIVING STATION.***SECONDARY-MAINTAIN CAPABILITY OF THE TOS-ESSA SATELLITE SYSTEM.

31. PRINCIPLES OF OPERATION

THIS SYSTEM, CONSISTING OF TWO IDENTICAL 1-INCH VIDICON APT CAMERAS, WAS ALSO TEST FLOWN ON TIROS 8 AND NIMBUS 1 AND 2 AND OPERATIONALLY FLOWN ON ESSA 2 AND 4. EACH CAMERA UTILIZES A TEGEA-KINOPTIC, 108-DEGREE, WIDE-ANGLE, F/1.8 OBJECTIVE LENS WITH A FOCAL LENGTH OF 5.7 MM. THE TWO CAMERAS ARE MOUNTED 180 DEGREES APART ON THE SIDE OF THE SPACECRAFT AND PERPENDICULAR TO THE SPIN AXIS, SO THEY POINT DIRECTLY DOWNWARD ONCE EVERY 5.5 SECS DURING WHICH TIME PICTURES ARE TAKEN. THE SYSTEM IS PROGRAMMED TO TAKE AND TRANSMIT A PICTURE EVERY 350 SECS FOR A TOTAL OF 8 PICTURES, WHILE THE SATELLITE IS IN DAYLIGHT. THE ACTUAL PICTURE TAKING REQUIRES 8 SECS AND THE TRANSMISSION 200 SECS. DURING THIS LATTER PERIOD THE VIDICON IS SCANNED AT FOUR LINES PER SECOND, AND THE SIGNALS TRANSMITTED PRODUCING AN 800-LINE PICTURE WITH SCAN LINES PERPENDICULAR TO THE ORBIT TRACK. THE SHUTTER UTILIZED IS A MODIFIED TIROS TYPE-F, FULL SCAN, FOCAL-PLANE SHUTTER ADJUSTED FOR A 1.5-MSEC EXPOSURE. TWO 5-WATT TV TRANSMITTERS ARE USED, EACH PROVIDING A 137.5-MHZ CARRIER. AN APT GROUND STATION WITH AN APPROPRIATE ANTENNA, RECEIVER, AND A RECORDER CAN RECEIVE THESE PICTURES WHEN THE SPACECRAFT IS WITHIN ACQUISITION RANGE.

32. PHENOMENA OBSERVED

CLOUD AND TERRAIN FEATURES OF APPROXIMATELY 2 NM OR LARGER

33. MEASUREMENT RANGE

DYNAMIC PICTURE RANGE OF 25:1

34. PRECISION AND ACCURACY

S/N OF 30 DB AT 0.7 FOOT CANDLES/SEC; 10 LEVELS OF GRAY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.45 TO 0.65 MICRON	NA	

38. FIELD OF VIEW	39. GROUND SWATH
89.0 BY 89.0 DEG	1800 NM BY 1800 NM FROM 750 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.132 DEG	1.7 NM FROM 750 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED CIRCULAR	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

2 VIDICON CAMERAS, 2 ELECTRONICS MODULES, 2 FM TRANSMITTERS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
55 LB		28 WATTS		40 WATTS	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
SENSITIVE	SENSITIVE			MAGNETIC SHIELDING USED

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
	REALTIME TELEMETRY	CONTINUOUS DAYTIME

62. TELEMETRY REQUIREMENTS

THE VIDEO OUTPUT, TURN-ON, AND PHASING CODE DRIVE A MODULATOR WHICH AMPLITUDE MODULATES THE 2400 HZ SUBCARRIER, THUS REQUIRING 4000 HZ MAXIMUM FREQUENCY CAPABILITY.

63. ADVANTAGES AND LIMITATIONS

DIRECT TRANSMISSION TO MANY GROUND STATIONS WITHOUT INTERMEDIATE STORAGE ON MAGNETIC TAPE.

64. REFERENCES

1) APT USERS GUIDE ESSA, NAT WEATHER SAT CTR, 1965.***2) STAMPFL, R.A. AND STROUD, W.G.: THE APT TV CAMERA SYSTEM FOR MET SATS. NASA/GSFC TN D-1915, NOV. 1963.***3) FINAL ENGINEERING REPORT, TOS/OT-2. RCA CORP. MAY 1967.***4) SIG ACHIEV IN SPACE APP. 1966 NASA SP-156.***5) OSTROW, H. AND WEINSTEIN, O.: REVIEW OF A DECADE OF SPACE CAMERA SYSTEMS DEVELOPMENT FOR MET. GSFC, 1968.

65. HISTORICAL REMARKS

SIMILAR TO APT ON TIROS 8, NIMBUS 1 AND 2, AND ESSA 2 AND 4.

66. DIAGRAMS

ESSA 7

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
ADVANCED VIDICON CAMERA SYSTEM	AVCS	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
O'BRIEN, J.J. (T.MON)	GODDARD SPACE FLT CENTER	301-982-5716
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					FLT MODEL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GLOVER, J.C.	NESC/ESSA		301-440-7543

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
RCA ASTRO-ELECTRONICS	PRINCETON, N.J.	08/68	

26. INSTRUMENT TYPE	27. SECURITY
IMAGER, 1-INCH WIDE-ANGLE HIGH-RESOLUTION VIDICON	UNC

28. APPLICATION	29. SPACECRAFT
MET, ERSP	ESSA 7

30. PURPOSE

PRIMARY-TO PROVIDE METEOROLOGICAL DATA IN THE FORM OF WIDE-ANGLE HIGH-RESOLUTION TELEVISION PICTURES OF EARTH'S CLOUD COVER BY TRANSMITTING PRERECORDED TV PICTURES TO CDA STATIONS.*** SECONDARY-TO MAINTAIN OPERATIONAL CAPABILITY OF THE AVCS.

31. PRINCIPLES OF OPERATION

THE AVCS, ON THIS AND THE ESSA 9 SPACECRAFT WAS TEST FLOWN ON NIMBUS 1 AND 2 AND OPERATIONALLY ON ESSA 3 AND 5. ALL ARE SIMILAR EXCEPT FOR DIFFERENT CAMERA LENSES. THE ESSA/TOS SPACECRAFT HAVE 2 CAMERAS WHILE NIMBUS HAD 3. THE ESSA/TOS SYSTEM CONSISTS OF 2 IDENTICAL 1-INCH VIDICONS HAVING 833 TV LINE RESOLUTION. THE CAMERAS ARE MOUNTED 180 DEGREES APART ON THE SIDE OF THE SPACECRAFT AND PERPENDICULAR TO THE SPIN AXIS. DURING PICTURE-TAKING SEQUENCE THE CAMERA LOOKS AT THE NADIR. THE LENS IS A TEGEA-KINOPTIC 108-DEGREE WIDE-ANGLE LENS WITH A FOCAL LENGTH OF 6.0 MM AND AN ELECTROMAGNETICALLY CONTROLLED SHUTTER. THE CAMERA CONVERTS THE OPTICAL IMAGE TO AN ELECTRICAL SIGNAL WHICH IS PROCESSED AND RECORDED ON MAGNETIC TAPE RECORDER. THE VIDICON HAS AN INHERENT STORAGE PROPERTY WHICH PERMITS A NOMINAL 6.5 SECOND FRAME-SCAN TIME. CONCURRENT WITH SHUTTER ACTUATION, A 16-INCREMENT GRAY SCALE IS INCLUDED AT THE EDGE OF EACH PICTURE FRAME AS A CONTRAST CHECK. THE CAMERA IS INDEPENDENTLY TRIGGERED INTO OPERATION ONLY WHEN IT COMES INTO VIEW OF THE EARTH. THE 4 TRACK MAGNETIC TAPE RECORDER CAN STORE UP TO 36 PICTURES. EACH CAMERA CAN TAKE 6 OR 12 CLOUD COVER PICTURES PER ORBIT AT 260-SECOND INTERVALS WITH A 50 PERCENT OVERLAP.

32. PHENOMENA OBSERVED

CLOUD COVER OF EARTH (REFLECTED VISIBLE SOLAR RADIATION)

33. MEASUREMENT RANGE

DYNAMIC RANGE OF 14 TO 11,400 FOOT LAMBERTS

34. PRECISION AND ACCURACY

833-LINE RESOLUTION, 16 LEVELS OF GRAY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.45 TO 0.65 MICRONS	NA	40. MILLSEC

38. FIELD OF VIEW	39. GROUND SWATH
89.0 BY 89.0 DEG	1700 NM BY 1700 NM FROM 750 NM ALTITUDE.

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.17 DEG	1.5 NM PER TV LINE AT CENTER FROM 750 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
0.5 DEG		MED CIRCULAR	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

2 TV CAMERA SYSTEMS, 2 TAPE RECORDERS, SYSTEM ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
43 LB		16 WATTS			

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
	SENSITIVE			MAGNETIC SHIELDING

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
GRAY SCALE CALIBRATION	DELAYED TELEMETRY	DAYSIDE OF ORBIT

62. TELEMETRY REQUIREMENTS

RECORDER IS PLAYED BACK ON CDA STATION COMMAND VIA THE SPACECRAFT 235 MHZ TRANSMITTER. TRANSMISSION TIME FOR A FULL ORBIT OF PICTURES IS APPROX 3 MINUTES.

63. ADVANTAGES AND LIMITATIONS

CAMERA MOUNTING ALLOWS PICTURES TO BE TAKEN STRAIGHT DOWN, MINIMIZING DISTORTION AND INCREASING ACCURACY.

64. REFERENCES

1) FINAL ENGINEERING REPORT TOS A, VOL 1,2,3. RCA ASTRO-ELECTRONICS, CONTRACT NO. NAS 5-9034, MAY 5, 1967.***2) SIG ACHIEV IN SPACE APP 1966. NASA SP-156, 1967.***3) OSTROW,H. AND WEINSTEIN, O.: REVIEW OF A DECADE OF SPACE CAMERA SYSTEMS DEVELOPMENT FOR METEOROLOGY. NASA/GSFC, AUG. 1968.***4) DATA AVAILABLE FROM NATIONAL WEATHER RECORDS CTR (ESSA), ASHEVILLE, N.C.

65. HISTORICAL REMARKS

TEST FLOWN ON NIMBUS 1 AND 2; OPERATIONAL ON ESSA 3, 5, AND 9.

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
LOW-RESOLUTION INFRARED RADIOMETER	LRIR	
(TITLE CONT.)	4. RESUME DATE: 11/10/69	5. VERSION: 0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
PARENT, DR. R.J.	UNIVERSITY OF WISCONSIN	608-262-5938
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					POST FLIGHT

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GLOVER, J.C.	NESC/ESSA		301-440-7543

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
UNIVERSITY OF WISCONSIN	MADISON, WISCONSIN	08/68	

26. INSTRUMENT TYPE	27. SECURITY
RADIOMETER, FLAT-PLATE IR/VISIBLE LOW-RESOLUTION	UNC

28. APPLICATION	29. SPACECRAFT
MET	ESSA 7

30. PURPOSE

PRIMARY-TO GATHER DATA TO AID IN DETERMINING: (1) THE GEOGRAPHIC DISTRIBUTION OF ENERGY RADIATED FROM THE EARTH AND THE RELATIONSHIP OF THIS ENERGY TO INCOMING ENERGY FROM THE SUN AND (2) THE REFLECTION AND SCATTERING OF SOLAR RADIATION BY THE EARTH-ATMOSPHERE SYSTEM.

31. PRINCIPLES OF OPERATION

THE ESSA FLAT PLATE RADIOMETER SYSTEM, IS DIVIDED INTO 2 BASIC COMPONENTS: A FLAT PLATE RADIOMETER WITH A 180 DEG FOV, AND A FLAT PLATE RADIOMETER EMPLOYING A CONE SHIELD TO MINIMIZE OR REMOVE ANY RESPONSE DUE TO DIRECT SOLAR RADIATION (70 DEG FOV). THE HEART OF EACH SENSOR IS A THIN ALUMINUM DISK THERMALLY AND RADIATIVELY ISOLATED FROM ITS MOUNTS. THE DISK TEMPERATURE IS SENSED BY 2 THERMISTORS MOUNTED ON THE BACK SURFACE OF THE DISK. THE HOUSING TEMPERATURES AND THE CONE TEMPERATURES ARE SEPARATELY SENSED AND RECORDED. TWO SPECTRAL RESPONSES ARE PROVIDED FOR THE DISKS BY THE USE OF ANODIZED ALUMINUM OR BLACK PAINT. THE BLACK PAINTED SURFACE WILL RESPOND TO THE SUM OF THE REFLECTED SOLAR, DIRECT SOLAR, AND RERADIATED LONG WAVE RADIATION. THE ANODIZED ALUMINUM SENSOR DISKS REFLECT IN THE VISIBLE RANGE BUT ABSORB IR RADIATION IN THE 7 TO 30 MICRON RANGE. THESE RESPOND TO THE RADIATED ENERGY FROM THE EARTH AND EXCLUDE TO A HIGH DEGREE THE DIRECT AND REFLECTED SOLAR RADIATION. BOTH DISK TYPES ARE USED WITH BOTH RADIOMETERS SO THAT 4 RADIOMETERS ARE NEEDED TO COMPLETE A SET. TWO SUCH SETS ARE MOUNTED 180 DEG APART ON THE S/C BUT ISOLATED THERMALLY AND RADIATIVELY FROM IT.

32. PHENOMENA OBSERVED

ENERGY RADIATED FROM AND REFLECTED BY THE EARTH/ATMOSPHERE

33. MEASUREMENT RANGE

34. PRECISION AND ACCURACY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.3 TO 30.0 MICRONS		

38. FIELD OF VIEW	39. GROUND SWATH
SEE ITEM 31	LIMB-TO-LIMB (4200 NM) FROM 750 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED CIRCULAR	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

8 SENSORS (THERMISTORS), ELECTRONICS, RECORDER

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
			SENSITIVE	FPR THERMALLY ISOLATED

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
	DELAYED TELEMETRY	CONTINUOUS

62. TELEMETRY REQUIREMENTS

90 KBITS TAPE CAPACITY.

63. ADVANTAGES AND LIMITATIONS

THE FPR DID NOT GET GOOD DATA STARTS. THUS TIME ERRORS WERE INCURRED IN MOST READOUTS.

64. REFERENCES

1) FINAL ENGINEERING REPORT TOS A MET SAT SYSTEM, VOL 1. RCA ASTRO-ELECTRONICS, CONTRACT NO. NAS5-9034, MAY 5, 1967.***2) RUBIN, L.: OPERATIONAL PROCESSING OF LOW RESOLUTION IR (LRIR) DATA FROM ESSA SATELLITES. ESSA TECH REPORT NESC-42, FEB. 68.*** 3) ESSA NEWS RELEASE NO. ES 66-54, SEPT 19, 1968.***4) DATA AVAILABLE FROM NESC, ESSA, WASH. D.C.

65. HISTORICAL REMARKS

THIS RADIOMETER WILL ALSO FLY ON ITOS A, B, C, AND D.

66. DIAGRAMS

ESSA 8

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
AUTOMATIC PICTURE-TRANSMISSION SYSTEM	APT	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
O'BRIEN,J.J.(T.MON)	GODDARD SPACE FLT CENTER	301-982-5716
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					FLT MODEL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GLOVER, J.C.	NESC/ESSA		301-440-7543

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
RCA ASTRO-ELECTRONICS	PRINCETON, N.J.	12/68	

26. INSTRUMENT TYPE	27. SECURITY
IMAGER, 1-INCH AUTOMATIC-PICTURE-TRANSMISSION VIDICON	

28. APPLICATION	29. SPACECRAFT
MET	ESSA 8

30. PURPOSE

PRIMARY- TO PROVIDE REALTIME CLOUD COVER PICTURES OVER A LARGE AREA AROUND ANY SUITABLY EQUIPPED RECEIVING STATION. *** SECONDARY- TO MAINTAIN CAPABILITY OF THE TOS-ESSA SATELLITE SYSTEM.

31. PRINCIPLES OF OPERATION

THIS SYSTEM, NOW WELL-USED, CONSISTING OF TWO IDENTICAL 1-INCH VIDICON APT CAMERAS, WAS ALSO TEST FLOWN ON TIROS 8 AND NIMBUS 1 AND 2 AND OPERATIONALLY FLOWN ON ESSA 2,4, AND 6. EACH CAMERA UTILIZES A TEGEA-KINOPTIC, 108-DEG WIDE-ANGLE, F/1.8 OBJECTIVE LENS WITH A FOCAL LENGTH OF 5.7 MM. THE 2 CAMERAS ARE MOUNTED 180 DEG APART ON THE SIDE OF THE SPACECRAFT AND PERPENDICULAR TO THE SPIN AXIS, SO THEY POINT DIRECTLY DOWNWARD ONCE EVERY 5.5 SECS, DURING WHICH TIME PICTURES ARE TAKEN. THE SYSTEM IS PROGRAMMED TO TAKE AND TRANSMIT A PICTURE EVERY 350 SECS FOR A TOTAL OF 8 PICTURES, WHILE THE SATELLITE IS IN DAYLIGHT. THE ACTUAL PICTURE TAKING REQUIRES 8 SECS AND THE TRANSMISSION 200 SECS. DURING THIS LATTER PERIOD THE VIDICON IS SCANNED AT FOUR LINES PER SECOND, AND THE SIGNALS TRANSMITTED PRODUCING AN 800-LINE PICTURE WITH SCAN LINES PERPENDICULAR TO THE ORBIT TRACK. THE SHUTTER UTILIZED IS A MODIFIED TIROS TYPE-F, FULL-SCAN, FOCAL-PLANE SHUTTER, ADJUSTED FOR A 1.5 MILSEC EXPOSURE. TWO 5-WATT TV TRANSMITTERS ARE USED, EACH PROVIDING A 137.5-MHZ CARRIER. AN APT GROUND STATION WITH AN APPROPRIATE ANTENNA, RECEIVER, AND A RECORDER CAN RECEIVE THESE PICTURES WHEN THE SPACECRAFT IS WITHIN ACQUISTION RANGE.

32. PHENOMENA OBSERVED

CLOUD AND TERRAIN FEATURES OF APPROX 2 NM OR LARGER

33. MEASUREMENT RANGE

DYNAMIC PICTURE RANGE 25:1

34. PRECISION AND ACCURACY

S/N OF 30 DB AT 0.7 FOOT-CANDLES/SEC; 10 LEVELS OF GRAY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.45 TO 0.65 MICRON	NA	

38. FIELD OF VIEW	39. GROUND SWATH
89.0 BY 89.0 DEG	1800 NM BY 1800 NM FROM 750 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.132 DEG	1.7 NM FROM 740 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED CIRCULAR	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

2 VIDICON CAMERAS, 2 ELECTRONICS MODULES, 2 FM TRANSMITTERS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
55 LB		28 WATTS		40 WATTS	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
	SENSITIVE			MAGNETIC SHIELDING USED

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
	REALTIME TELEMETRY	CONTINUOUS DAYTIME

62. TELEMETRY REQUIREMENTS

THE VIDEO OUTPUT, TURN-ON, AND PHASING CODE DRIVE A MODULATOR WHICH AMPLITUDE MODULATES THE 2400 HZ SUBCARRIER, THUS REQUIRING 4000 HZ MAXIMUM FREQUENCY CAPABILITY.

63. ADVANTAGES AND LIMITATIONS

DIRECT TRANSMISSION TO MANY GROUND STATIONS WITHOUT INTERMEDIATE STORAGE ON MAGNETIC TAPE. 2 CAMERAS INSURE LONG OPERATING PERIOD

64. REFERENCES

1) APT USERS GUIDE. ESSA, NAT WEATHER SAT CTR, 1965.***2) STAMPFL, R.A. AND STROUD, W.G.: THE APT TV CAMERA SYSTEM FOR MET SATS. NASA/GSFC TN D-1915, NOV. 1963.***3) FINAL ENGINEERING REPORT, TOS/OT-2. RCA CORP. MAY 1967.***4) SIG ACHIEV IN SPACE APP, 1966. NASA SP-156.***5) OSTROW, H. AND WEINSTEIN, O.: REVIEW OF A DECADE OF SPACE CAMERA SYSTEMS DEVELOPMENT FOR MET. GSFC, 1968.

65. HISTORICAL REMARKS

FLOWN ON TIROS 8, NIMBUS 1 AND 2, AND ESSA 2, 4 AND 6.

66. DIAGRAMS

ESSA 9

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
ADVANCED VIDICON CAMERA SYSTEM	AVCS	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
O'BRIEN, J.J. (T.MON)	GODDARD SPACE FLT CENTER	301-982-5716
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					FLT MODEL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GLOVER, J.C.	NESC/ESSA		301-440-7543

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
RCA ASTRO-ELECTRONICS	PRINCETON, N.J.	02/69	

26. INSTRUMENT TYPE	27. SECURITY
IMAGER, 1-INCH WIDE-ANGLE HIGH-RESOLUTION VIDICON	UNC

28. APPLICATION	29. SPACECRAFT
MET, ERSP	ESSA 9

30. PURPOSE

PRIMARY-TO PROVIDE METEOROLOGICAL DATA IN THE FORM OF WIDE-ANGLE HIGH-RESOLUTION TELEVISION PICTURES OF EARTH'S CLOUD COVER; BY TRANSMITTING PRERECORDED TV PICTURES TO CDA STATIONS.*** SECONDARY- TO MAINTAIN OPERATIONAL CAPABILITY OF THE AVCS

31. PRINCIPLES OF OPERATION

THE AVCS, NOW A WELL-USED INSTRUMENT, WAS TEST FLOWN ON NIMBUS 1 AND 2 AND OPERATIONALLY ON ESSA 3, 5 AND 7. ALL ARE SIMILAR EXCEPT FOR DIFFERENT CAMERA LENSES. THE ESSA/TOS SPACECRAFT HAVE 2 CAMERAS WHILE NIMBUS HAD 3. THE ESSA/TOS SYSTEM CONSISTS OF 2 IDENTICAL 1-INCH VIDICONS HAVING 833-TV-LINE RESOLUTION. THE CAMERAS ARE MOUNTED 180 DEGREES APART ON THE SIDE OF THE SPACECRAFT AND PERPENDICULAR TO THE SPIN AXIS. DURING PICTURE TAKING SEQUENCE THE CAMERA LOOKS AT THE NADIR. THE LENS IS A TEGEA-KINOPTIC 108-DEGREE WIDE-ANGLE LENS WITH A FOCAL LENGTH OF 6.0 MM AND AN ELECTROMAGNETICALLY CONTROLLED SHUTTER. THE CAMERA CONVERTS THE OPTICAL IMAGE TO AN ELECTRICAL SIGNAL WHICH IS PROCESSED AND RECORDED ON A MAGNETIC TAPE RECORDER. THE VIDICON HAS AN INHERENT STORAGE PROPERTY WHICH PERMITS A NOMINAL 6.5 SECOND FRAME SCAN TIME. CONCURRENT WITH SHUTTER ACTUATION A 16-INCREMENT GRAY SCALE IS INCLUDED AT THE EDGE OF EACH PICTURE FRAME AS A CONTRAST CHECK. THE CAMERA IS INDEPENDENTLY TRIGGERED INTO OPERATION ONLY WHEN IT COMES IN VIEW OF THE EARTH. THE 4 TRACK MAGNETIC TAPE RECORDER CAN STORE UP TO 36 PICTURES. EACH CAMERA CAN TAKE 6 OR 12 CLOUD COVER PICTURES PER ORBIT AT 260-SECOND INTERVALS WITH A 50 PERCENT OVERLAP.

32. PHENOMENA OBSERVED

CLOUD COVER OF EARTH (REFLECTED VISIBLE SOLAR RADIATION)

33. MEASUREMENT RANGE

DYNAMIC RANGE OF 14 TO 11,400 FOOT-LAMBERTS

34. PRECISION AND ACCURACY

833-LINE RESOLUTION, 16 LEVELS OF GRAY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.45 TO 0.65 MICRON	NA	40. MILLSEC

38. FIELD OF VIEW	39. GROUND SWATH
89.0 BY 89.0 DEG	1700 NM BY 1700 NM FROM 750 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.17 DEG	1.5 NM PER TV LINE AT CENTER FROM 750 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
0.5 DEG		MED CIRCULAR	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

2 TV CAMERA SYSTEMS, 2 TAPE RECORDERS, SYSTEM ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
43 LB		16 WATTS			

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
	SENSITIVE			MAGNETIC SHIELDING USED

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
GRAY-SCALE CALIBRATION	DELAYED TELEMETRY	DAYSIDE OF ORBIT

62. TELEMETRY REQUIREMENTS

RECORDER IS PLAYED BACK ON CDA STATION COMMAND VIA THE SPACECRAFT 235-MHZ TRANSMITTER. TRANSMISSION TIME FOR A FULL ORBIT OF PICTURES IS APPROX 3 MINUTES.

63. ADVANTAGES AND LIMITATIONS

CAMERA MOUNTING ALLOWS PICTURES TO BE TAKEN STRAIGHT DOWN, MINIMIZING DISTORTION AND INCREASING ACCURACY.

64. REFERENCES

1) FINAL ENGINEERING REPORT TOS A, VOL.1,2,3. RCA ASTRO-ELECTRONICS, CONTRACT NO. NAS 5-9034, MAY 5,1967.**2) SIG ACHIEV IN SPACE APP 1966. NASA SP-156, 1967.***3) OSTROW, H. AND WEINSTEIN O.: REVIEW OF A DECADE OF SPACE CAMERA SYSTEMS DEVELOPMENT FOR METEOROLOGY. NASA/GSFC, AUG. 1968.***4) DATA AVAILABLE FROM NATIONAL WEATHER RECORDS CTR (ESSA), ASHEVILLE, N.C.

65. HISTORICAL REMARKS

FLOWN ON NIMBUS 1, 2 AND ESSA 3, 5 AND 7.

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
LOW-RESOLUTION INFRARED RADIOMETER	LRIR	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
PARENT, DR. R.J.	UNIVERSITY OF WISCONSIN	608-262-5938
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					POST FLIGHT

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GLOVER, J.C.	NESC/ESSA		301-440-7543

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
UNIVERSITY OF WISCONSIN	MADISON, WISCONSIN	02/69	

26. INSTRUMENT TYPE	27. SPONSOR
RADIOMETER, FLAT-PLATE IR/VISIBLE LOW-RESOLUTION	UNC

28. APPLICATION	29. SPACECRAFT
MET	ESSA 9

30. PURPOSE

PRIMARY-TO GATHER DATA TO AID IN DETERMINING: (1) THE GEOGRAPHIC DISTRIBUTION OF ENERGY RADIATED FROM THE EARTH AND THE RELATIONSHIP OF THIS ENERGY TO INCOMING ENERGY FROM THE SUN AND (2) THE REFLECTION AND SCATTERING OF SOLAR RADIATION BY THE EARTH-ATMOSPHERE SYSTEM.

31. PRINCIPLES OF OPERATION

THE ESSA FLAT PLATE RADIOMETER SYSTEM, IS DIVIDED INTO 2 BASIC COMPONENTS: A FLAT PLATE RADIOMETER WITH A 180 DEG FOV, AND A FLAT PLATE RADIOMETER EMPLOYING A CONE SHIELD TO MINIMIZE OR REMOVE ANY RESPONSE DUE TO DIRECT SOLAR RADIATION (70 DEG FOV). THE HEART OF EACH SENSOR IS A THIN ALUMINUM DISK THERMALLY AND RADIATIVELY ISOLATED FROM ITS MOUNTS. THE DISK TEMPERATURE IS SENSED BY 2 THERMISTORS MOUNTED ON THE BACK SURFACE OF THE DISK. THE HOUSING TEMPERATURES AND THE CONE TEMPERATURES ARE SEPARATELY SENSED AND RECORDED. TWO SPECTRAL RESPONSES ARE PROVIDED FOR THE DISKS BY THE USE OF ANODIZED ALUMINUM OR BLACK PAINT. THE BLACK PAINTED SURFACE WILL RESPOND TO THE SUM OF THE REFLECTED SOLAR, DIRECT SOLAR, AND RERADIATED LONG WAVE RADIATION. THE ANODIZED ALUMINUM SENSOR DISKS REFLECT IN THE VISIBLE RANGE BUT ABSORB IR RADIATION IN THE 7 TO 30 MICRON RANGE. THESE RESPOND TO THE RADIATED ENERGY FROM THE EARTH AND EXCLUDE TO A HIGH DEGREE THE DIRECT AND REFLECTED SOLAR RADIATION. BOTH DISK TYPES ARE USED WITH BOTH RADIOMETERS SO THAT 4 RADIOMETERS ARE NEEDED TO COMPLETE A SET. TWO SUCH SETS ARE MOUNTED 180 DEG APART ON THE S/C BUT ISOLATED THERMALLY AND RADIATIVELY FROM IT.

32. PHENOMENA OBSERVED

ENERGY RADIATED FROM AND REFLECTED BY THE EARTH/ATMOSPHERE

33. MEASUREMENT RANGE

34. PRECISION AND ACCURACY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.3 TO 30.0 MICRONS		

38. FIELD OF VIEW	39. GROUND SWATH
SEE ITEM 31	LIMB-TO-LIMB (4200 NM) FROM 750 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED CIRCULAR	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

8 SENSORS (THERMISTORS), ELECTRONICS, RECORDER

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
			SENSITIVE	FPR THERMALLY ISOLATED

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
	DELAYED TELEMETRY	CONTINUOUS

62. TELEMETRY REQUIREMENTS

90 KBITS TAPE CAPACITY.

63. ADVANTAGES AND LIMITATIONS

THE FPR DID NOT GET GOOD DATA STARTS. THUS TIME ERRORS WERE INCURRED IN MOST READOUTS.

64. REFERENCES

1) FINAL ENGINEERING REPORT TOS A MET SAT SYSTEM, VOL 1. RCA ASTRO-ELECTRONICS, CONTRACT NO. NAS5-9034, MAY 5, 1967.***2) RUBIN, L.: OPERATIONAL PROCESSING OF LOW RESOLUTION IR (LRIR) DATA FROM ESSA SATELLITES. ESSA TECH REPORT NESC-42, FEB. 68.*** 3) ESSA NEWS RELEASE NO. ES 66-54, SEPT 19, 1968.***4) DATA AVAILABLE FROM NESC, ESSA, WASH. D.C.

65. HISTORICAL REMARKS

THIS RADIOMETER WILL ALSO FLY ON ITOS A, B, C, AND D.

66. DIAGRAMS

EXPLORER 7

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
LOW-RESOLUTION OMNIDIRECTIONAL RADIOMETER	LROR	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
SUOMI, DR. V.E.	UNIVERSITY OF WISCONSIN	608-262-5938
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					POST FLIGHT

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
HOLTZ, J.R.	NASA HDQTRS	OSSA/SG	202-962-3825

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
UNIVERSITY OF WISCONSIN	MADISON, WISCONSIN	10/59	NA

26. INSTRUMENT TYPE	27. SECURITY
RADIOMETER, IR OMNIDIRECTIONAL NON-SCANNING LOW-RESOLUTION	UNC

28. APPLICATION	29. SPACECRAFT
MET	EXPLORER 7

30. PURPOSE

PRIMARY-TO MEASURE THE GROSS HEAT BUDGET OF THE EARTH.***
SECONDARY-TO DETERMINE HOW MUCH SOLAR ENERGY IS ABSORBED, REFLECTED, AND EMITTED BY THE EARTH AND ITS ATMOSPHERE.

31. PRINCIPLES OF OPERATION

EXPERIMENTS SIMILAR TO THIS WERE ALSO FLOWN ON TIROS 3,4, AND 7. ON EXPLORER 7, THREE RADIATION CURRENTS ARE MEASURED WITH SIMPLE BOLOMETERS IN THE FORM OF HOLLOW SILVER HEMISPHERES. THE HEMISPHERES ARE THERMALLY ISOLATED FROM, BUT IN CLOSE PROXIMITY TO SPECIALLY ALUMINIZED MIRRORS. THESE MIRROR BACKED BOLOMETERS ARE MOUNTED ON THE EQUATOR OF THE SATELLITE. THE BOLOMETER'S TEMPERATURE IS MEASURED BY A GLASS COATED BEAD THERMISTOR MOUNTED ON THE HEMISPHERE. ALSO, PROVISION IS MADE TO MEASURE THE TEMPERATURE OF THE MIRRORS. TWO OF THE HEMISPHERES HAVE A BLACK COATING AND RESPOND ABOUT EQUALLY TO SOLAR AND TERRESTRIAL RADIATION. A THIRD HEMISPHERE, WHITE, IS MORE SENSITIVE TO TERRESTRIAL RADIATION THAN TO SOLAR RADIATION. A FOURTH WITH A GOLD METAL SURFACE IS MORE SENSITIVE TO SOLAR RADIATION THAN TO TERRESTRIAL RADIATION. A BLACK SPHERE, ON THE AXIS OF THE SATELLITE AT THE TOP, IS USED TO DETERMINE ANY DETERIORATION IN THE MIRROR SURFACES BY COMPARISON WITH BLACKENED HEMISPHERES. A SMALL TABOR-SURFACED HEMISPHERE, PROTECTED FROM DIRECT SUNLIGHT CAN BE USED TO MEASURE REFLECTED SUNLIGHT WHEN THE AXIS OF THE SATELLITE POINTS TO THE EARTH'S SURFACE. THE RADIATION CURRENTS ARE OBTAINED BY USING THESE TEMPERATURES IN HEAT BALANCE EQUATIONS.

32. PHENOMENA OBSERVED

SOLAR AND TERRESTRIAL RADIATION

33. MEASUREMENT RANGE

128 DEG K TO 488 DEG K

34. PRECISION AND ACCURACY

0.1 KELVIN DEGREE

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.3 TO 60.0 MICRON	NA	5. SECONDS

38. FIELD OF VIEW	39. GROUND SWATH
180.0 DEG	300 NM RADIUS CIRCLE FROM 375 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
NA	

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
NA	NA	MED ECCENTRIC	HIGH POSIGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

5 MIRROR-BACKED BOLOMETERS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
3 LB					3 YRS

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
			SENSITIVE	MIRRORS SHIELD SENSORS

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
	REALTIME TELEMETRY	CONTINUOUS

62. TELEMETRY REQUIREMENTS

DATA SENT ON THE 730 HZ SUBCARRIER IN THE FORM OF A TEN-BIT NATURAL BINARY-CODED WORD. BANDWIDTH USED FOR TRANSMISSION IS 10 HZ.

63. ADVANTAGES AND LIMITATIONS

NO DATA STORAGE, DATA LIMITED TO TIME WHEN SATELLITE IN VIEW OF RECEIVING STATION.

64. REFERENCES

1) JUNO 2 SUMMARY PROJECT REPORT, VOL 1. EXPLORER 7 SAT. NASA TECH NOTE D-608, JULY 1961.***2) TELEMETRY CODE AND CALIBRATIONS FOR SATELLITE 1959 IOTA (EXPLORER 7). NASA TECH NOTE D-484, MAY 1960.***3) DATA AVAILABLE FROM NASA/NATIONAL SPACE SCIENCE DATA CENTER.***4) FINAL SCIENTIFIC REPORT ON CONTRACT NASW-65. DEPT. OF METEOROLOGY, UNIV. OF WISCONSIN, DEC. 1968.

65. HISTORICAL REMARKS

AN EARLY VERSION OF A RADIOMETER USED ON TIROS AND ESSA S/C.

66. DIAGRAMS

GEOS 2

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
C-BAND PASSIVE REFLECTOR	CPAR	
(TITLE CONT.)	4. RESUME DATE: 11/10/69	5. VERSION: 0003

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
STANLEY, H. R.	NASA WALLOPS STATION	
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					OPERATIONAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
ROSENBERG, J.D.	NASA HDQTRS	OSSA/SCG	202-963-3361

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
		01/68	NA

26. INSTRUMENT TYPE	27. SECURITY
REFLECTOR, C-BAND PASSIVE	UNC

28. APPLICATION	29. SPACECRAFT
GEOD	GEOS 2

30. PURPOSE

PRIMARY-TO ALLOW A MORE PRECISE CALIBRATION OF THE TRANSPONDER INTERNAL TIME DELAY; USED IN CONJUNCTION WITH THE C-BAND TRANSPONDER.***SECONDARY-TO PROVIDE PASSIVE C-BAND TRACKING CAPABILITIES.

31. PRINCIPLES OF OPERATION

THIS PASSIVE C-BAND REFLECTOR IS INCLUDED ON THE SPACECRAFT IN ORDER TO DETERMINE ACCURATELY THE LONG-TERM EFFECTS OF COMPONENTS AGING AND THE EFFECTS OF RADIATION UPON THE C-BAND TRANSPONDER SYSTEM. BY TRACKING THE SATELLITE WITH BOTH ACTIVE AND PASSIVE SYSTEMS DURING THE SAME PASS, THE CORRECTIONS TO THE ACTIVE SYSTEM MAY BE ACCURATELY DETERMINED. THE SYSTEM WILL ALSO PERMIT C-BAND TRACKING OF THE SATELLITE ON FREQUENCIES OTHER THAN THE TRANSPONDER INTERROGATE FREQUENCY THUS ENABLING GREATER TRACKING COVERAGE WITHOUT ADDITIONAL DRAIN FROM THE SPACECRAFT POWER SYSTEM.

32. PHENOMENA OBSERVED

RF (C-BAND) TRANSMISSIONS FROM GROUND STATIONS

33. MEASUREMENT RANGE

34. PRECISION AND ACCURACY

30 DB POINT IS 35 DEG FROM MAIN-BEAM DIRECTION

35. SPECTRAL RANGE | 36. SPECTRAL RESOLUTION | 37. TIME CONSTANT

NA

38. FIELD OF VIEW	39. GROUND SWATH
NA	NA
40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
NA	NA

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
NA	NA	MED ECCENTRIC HIGH	RETROGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

C-BAND PASSIVE REFLECTOR

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
		NONE	NONE	NONE	12 MON

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
	NONE	NONE		

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
	NA	AS PROGRAMMED

62. TELEMETRY REQUIREMENTS

NA

63. ADVANTAGES AND LIMITATIONS

64. REFERENCES

1) NASA PRESS KIT FOR GEOS-2. RELEASE NO: 68-2K, JAN 7, 68.***2) PLAN OF OPERATIONS FOR THE GEOS-B SPACECRAFT. REPORT NO. R-4035-45-2. COMMUNICATIONS AND SYSTEMS, INC. OCT 1967.***3) PARAMETRIC ANALYSIS FOR FUTURE GEODETIC SPACECRAFT DEVELOPMENT, REPORT NO. R-4035-50-2. COMMUNICATIONS AND SYSTEMS, INC. JAN 1968.

65. HISTORICAL REMARKS

GEOS 2 IS ALSO KNOWN AS EXPLORER 36

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
C-BAND TRANSPONDER	CTRAN	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0003

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
STANLEY, H. R.	NASA WALLOPS STATION	
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					OPERATIONAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
ROSENBERG, J. D.	NASA HDQTRS	OSSA/SCG	202-963-3361

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
VEGA PRECISION LABS	VIENNA, VA.	01/68	NA

26. INSTRUMENT TYPE	27. SECURITY
TRANSPONDER, 2 C-BAND VEGA MODEL 313 C	UNC

28. APPLICATION	29. SPACECRAFT
GEOD	GEOS 2

30. PURPOSE

PRIMARY-TO BE USED FOR RANGE RADAR CALIBRATION AND DATA RECORDING FOR EXPERIMENTATION TO DETERMINE THE ACCURACY OF THE RADAR SYSTEM FOR GEOMETRIC AND GRAVIMETRIC GEODESY INVESTIGATIONS. USED IN CONJUNCTION WITH THE C-BAND PASSIVE REFLECTOR EXPERIMENT.

31. PRINCIPLES OF OPERATION

THIS SYSTEM CONSISTS OF A PAIR OF REDUNDANT C-BAND TRANSPONDERS (VEGA MODEL 313C). THE TRANSPONDERS ARE IDENTICAL EXCEPT FOR INTERNAL DELAY TIME, 5 MICROSEC VS 0.7 MICROSEC WHICH ALLOWS TRANSPONDER IDENTIFICATION. EACH TRANSPONDER HAS ITS OWN CAVITY MOUNTED HELICAL ANTENNA. THE INTERROGATION FREQUENCY IS 5690 MHZ AND THE TRANSMITTER FREQUENCY (DOWNLINK) IS 5765 MHZ. THE TRANSPONDER RECEIVES A PAIR OF PULSES 8 MICROSECONDS APART FROM A GROUND STATION. EIGHT MICROSECONDS AFTER RECEIVING THE FIRST OF THESE PULSES AN INTERNAL GATING PULSE IS GENERATED. WHEN THIS GATING PULSE IS PRESENT, THE SECOND GROUND PULSE WILL GENERATE A RETURN PULSE AFTER A FIXED 4 OR 5 MICROSECOND DELAY (DEPENDING UPON WHICH OF THE TWO TRANSPONDERS IS IN OPERATION). RANGING IS OBTAINED AT THE GROUND VIA THE TIME REQUIRED TO MAKE THE ROUND TRIP LESS THE FIXED DELAY IN THE SPACECRAFT. THE SYSTEM RECEIVES POWER FROM THE TRANSPONDER BATTERY AND MUST TIME-SHARE THE AVAILABLE POWER WITH THE GHARR AND SECOR TRANSPONDERS. IN ORDER TO DETERMINE ACCURATELY THE LONG-TERM EFFECTS OF AGING AND RADIATION UPON THE TRANSPONDER SYSTEM, DATA IS COMPARED WITH THAT RETURNED FROM THE PASSIVE C-BAND REFLECTOR ALSO ON-BOARD.

32. PHENOMENA OBSERVED

RF TRANSMISSION FROM GROUND STATIONS AT 5690 MHZ

33. MEASUREMENT RANGE

RANGE GREATER THAN 4000 NM

34. PRECISION AND ACCURACY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
SEE ITEM 31	NA	

38. FIELD OF VIEW	39. GROUND SWATH

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
NA	NA

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
NA	NA	MED ECCENTRIC	HIGH RETROGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

2 VEGA MODEL 313C TRANSPONDERS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
8 LB			3 WATTS	500 WATTS	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
SOURCE	NONE	NONE	NONE	

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
NONE	NA	20-40 MIN PER DAY

62. TELEMETRY REQUIREMENTS

SEE ITEM 31

63. ADVANTAGES AND LIMITATIONS

64. REFERENCES

1) NASA PRESS KIT FOR GEOS-B. RELEASE NO: 68-2K, JAN 7, 68.***2) PARAMETRIC ANALYSIS FOR FUTURE GEODETIC SPACECRAFT DEVELOPMENT. REPORT NO. R-4035-50-2, COMMUNICATIONS AND SYSTEMS, INC. JAN 68. ***3) PLAN OF OPERATIONS FOR THE GEOS-B SPACECRAFT. REPORT NO. R-4035-45-2, COMMUNICATIONS SYSTEMS, INC. OCT, 67.

65. HISTORICAL REMARKS

GEOS 2 IS ALSO KNOWN AS EXPLORER 36

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
DOPPLER BEACON	DBEAC	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0003

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
ANDERLE, R.J.	NAVAL WEAPONS LABORATORY	
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					OPERATIONAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
ROSENBERG, J. D.	NASA HDQTRS	OSSA/SCG	202-963-3361

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
		01/68	NA

26. INSTRUMENT TYPE	27. SECURITY
BEACON, 3 RADIO-FREQUENCY TRANSMITTER	

28. APPLICATION	29. SPACECRAFT
GEOD	GEOS 2

30. PURPOSE

PRIMARY-TO REFINE KNOWLEDGE OF THE STRUCTURE OF THE EARTH'S GRAVITATIONAL FIELD.***SECONDARY-TO DETERMINE MORE ACCURATELY THE PRECISE POSITIONS OF THE U S NAVY TRANET GROUND STATIONS RELATIVE TO THE CENTER OF THE MASS OF THE EARTH.

31. PRINCIPLES OF OPERATION

THIS DOPPLER TRANSMITTER WAS FLOWN ON GEOS-1 AND ALSO HAS BEEN USED FOR GEODETIC RESEARCH IN EARLY NAVY SATELLITES, IN THE ANNA-1B AND IN THE NASA EXPLORER 27 SATELLITE. THE SYSTEM CONSISTS OF 3 RADIO-FREQUENCY TRANSMITTERS OPERATING AT 162, 325, AND 972 MHZ, 2 INTERCHANGABLE 5-MHZ STABLE OSCILLATORS, AND MULTIPLYING CIRCUITRY TO PROVIDE STABLE TRANSMITTER FREQUENCIES. THE USE OF 3 COHERENT RADIO FREQUENCIES, GENERATED BY THE MAIN OSCILLATOR, ALLOWS THE COMPUTATION AND CORRECTION OF THE IONOSPHERIC REFRACTION EFFECT ON THE DOPPLER FREQUENCY. THE DOPPLER BEACON ON THE SATELLITE TRANSMITS 250 MILLIWATT AT 162 MHZ, 400 MILLIWATT AT 325 MHZ AND 500 MILLIWATT AT 972 MHZ. THE 162 AND 325 MHZ TRANSMITTERS ARE MODULATED WITH THE TELEMETRY TIME MARKER WHILE THE THIRD TRANSMITTER IS UNMODULATED. THE DOPPLER BEACONS USE THE MAIN POWER SUPPLY OF THE SPACECRAFT AND TRANSMIT CONTINUOUSLY.

32. PHENOMENA OBSERVED

33. MEASUREMENT RANGE

34. PRECISION AND ACCURACY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
162. TO 972. MHZ	NA	NA

38. FIELD OF VIEW	39. GROUND SWATH

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION		
NA	NA		
42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
NA	NA	MED ECCENTRIC HIGH	RETROGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

3 RF TRANSMITTERS, 2 OSCILLATORS, AND CIRCUITRY

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
11 LB		10 WATTS		10 WATTS	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
SOURCE	NONE	NONE	NONE	

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
NONE	REALTIME TELEMETRY	CONTINUOUS

62. TELEMETRY REQUIREMENTS

SEE ITEM 31

63. ADVANTAGES AND LIMITATIONS

64. REFERENCES

1) NASA PRESS KIT FOR GEOS-B. RELEASE NO: 68-2K, JAN 7, 68.***2) PLAN OF OPERATIONS FOR THE GEOS-B SPACECRAFT, COMMUNICATIONS AND SYSTEMS, INC. REPORT NO. R-4035-45-2, OCT 1967.***3) PARAMETRIC ANALYSIS FOR FUTURE GEODETIC SPACECRAFT DEVELOPMENT. COMMUNICATION AND SYSTEMS, INC. REPORT NO. R-4035-50-2, JAN 1968.

65. HISTORICAL REMARKS

ALSO FLOWN ON GEOS 1 AND NAVY SATELLITES. GEOS 2 = EXPLORER 36

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
LASER DETECTOR	LDEC	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
PLOTKIN, DR. H.H.	GODDARD SPACE FLT CENTER	301-982-4942
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					OPERATIONAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
ROSENBERG, J. D.	NASA HDQTRS	OSSA/SCG	202-963-3361

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
WASHINGTON TECH. ASSOC.	ROCKVILLE, MARYLAND	01/68	NA

26. INSTRUMENT TYPE	27. SECURITY
PHOTOMETER, 4880-ANGSTROM CW-LASER PHOTOMULTIPLIER DETECTOR	UNC

28. APPLICATION	29. SPACECRAFT
GEOD	GEOS 2

30. PURPOSE

PRIMARY-TO DETERMINE WHETHER LASER BEAMS TRANSMITTED TO ORBITING SATELLITES ARRIVE AT THE SATELLITE AT PREDICTED POWER LEVELS.*** SECONDARY-TO DETERMINE THE FREQUENCY AND DEPTH OF MODULATION AND SCINTILLATION OF THE LASER BEAM AS VIEWED FROM THE SATELLITE.

31. PRINCIPLES OF OPERATION

THIS LASER DETECTOR WAS DESIGNED TO DETECT MODULATION OF AN ARGON LASER BEAM (4880 A WAVELENGTH) CHOPPED AT 13 KHZ. THE FIELD OF VIEW OF THE SYSTEM IS 80 DEG. A 0.6 IN (1.5 CM) DIAMETER APERTURE STOP AND A SET OF 2 LENSES THAT FORM A 2.2 IN (5.6 CM) FOCAL LENGTH, F/0.78 OBJECTIVE COLLIMATE THE LIGHT SO THAT THE BEAM STRIKES A WAVELENGTH FILTER WITHIN 8 DEG OF NORMAL. THE FILTER IS 2.70 IN (6.9 CM) IN DIAMETER WITH A PEAK TRANSMISSION OF 50 PERCENT AT 4890 A AND A HALF-POWER BANDWIDTH OF 46 A. TRANSMISSION OUTSIDE THIS PASSBAND IS LESS THAN 0.0063 PER CENT FROM 2500 TO 20000 A. AFTER THE FILTER, ANOTHER SET OF LENSES JUST LIKE THE OBJECTIVE CONDENSES THE LIGHT ONTO A 14 STAGE PHOTOMULTIPILER TUBE WITH A 1 IN (2.54 CM) DIAMETER BI-ALKALI PHOTOCATHODE (EMR TYPE 541D-01-14). FROM HERE AN OUTPUT SIGNAL GOES INTO AN FET PREAMPLIRIER THEN INTO A PIEZO-ELECTRIC FILTER WITH A 160 HZ BANDPASS CENTERED AT 13 KHZ. THUS THIS DETECTOR IS SENSITIVE ONLY TO MODULATION IN FREQUENCY OF LESS THAN 80 HZ. (THE MODULATIONS ARE EXPECTED TO BE PREDOMINATELY LESS THAN 10 HZ.) AFTER DETECTION A LOG AMPLIFIER COMPRESSES THE SIGNAL RANGE OF 1000 INTO A -5 TO +5 V RANGE FOR TELEMETRY.

32. PHENOMENA OBSERVED

CONTINUOUS-WAVE MODULATED ARGON-LASER LIGHT (4880 A)

33. MEASUREMENT RANGE

0.1 TO 100 PICOWATT

34. PRECISION AND ACCURACY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION.	37. TIME CONSTANT
4880. A	NA	

38. FIELD OF VIEW	39. GROUND SWATH
80.0 DEG	900 NM DIAM CIRCLE FROM 600 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
NA	NA

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
NA	NA	MED ECCENTRIC	HIGH RETROGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

PHOTOMULTIPLIER ASSEMBLY

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
4 LB	0.1 CU FT	2 WATTS		2 WATTS	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
	DELAYED TELEMETRY	10 MIN PER DAY

62. TELEMETRY REQUIREMENTS

DATA TELEMETERED VIA A 136.32-MHZ TRANSMITTER. BANDWIDTH NEEDED= 80 HZ.

63. ADVANTAGES AND LIMITATIONS

64. REFERENCES

1) NASA PRESS KIT FOR GEOS-B. RELEASE NO: 68-2K, JAN 7, 68.***2) PARAMETRIC ANALYSIS FOR FUTURE GEODETIC SPACECRAFT DEVELOPMENT. REPORT NO. R-4035-50-2, COMMUNICATIONS AND SYSTEMS, INC. JAN 68. ***3) PLAN OF OPERATIONS FOR THE GEOS-B SPACECRAFT. REPORT NO. R-4035-2, COMMUNICATIONS AND SYSTEMS, INC, OCT, 67.***4) DESIGN AND PERFORMANCE OF GEOS-LASER DETECTOR, TMX-63222, OCT. 67.

65. HISTORICAL REMARKS

GEOS 2 IS ALSO KNOWN AS EXPLORER 36.

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
LASER REFLECTOR	LREF	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0003

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
PLOTKIN, DR. H.H.	GODDARD SPACE FLT CENTER	301-982-4942
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					OPERATIONAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
ROSENBERG, J. D.	NASA HDQTRS	OSSA/SCG	202-963-3361

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
GE SPACE TECHNOLOGY CTR	VALLEY FORGE, PA	01/68	NA

26. INSTRUMENT TYPE	27. SENSITIVITY
REFLECTOR, 400 1-INCH CUBICAL SILVERED-PRISM	UNC

28. APPLICATION	29. SPACECRAFT
GEOD	GEOS 2

30. PURPOSE

PRIMARY-TO MAKE ACCURATE RANGE AND ANGLE MEASUREMENTS TO THE SATELLITE FROM ONE OR SEVERAL LOCATIONS SIMULTANEOUSLY, IN CONJUNCTION WITH LASER GROUND EQUIPMENT.***SECONDARY-TO OBTAIN MEASUREMENTS OF CONTINENTAL DRIFT AND THE TIDAL MOVEMENT OF LAND MASSES.

31. PRINCIPLES OF OPERATION

THIS IS AN ARRAY OF QUARTZ CUBIC CORNER REFLECTORS MOUNTED ON 4 OF THE 8 FLAT PANELS ON THE BOTTOM SURFACE OF THE SPACECRAFT. EACH REFLECTOR IS A FUSED QUARTZ PRISM ABOUT ONE INCH IN SIZE WITH SILVERED REFLECTING SURFACES. THERE ARE A TOTAL OF 400 PRISMS ON THE SPACECRAFT, PROVIDING A TOTAL REFLECTING AREA OF 360 SQUARE INCHES. THE PRISMS ARE JOINED TO AN ACCURACY OF 3 ARC-SEC AND REFLECT AT LEAST 50% OF THE INCIDENT BEAM ANTI-PARALLEL WITHIN A 20 ARC-SEC CONE. THE EFFECTIVE USABLE ANGLE OF THE REFLECTORS IS CONTAINED WITHIN A CONE OF 40-DEG HALF-ANGLE FROM THE SATELLITE NADIR. WHEN THE SATELLITE IS WITHIN RANGE, THESE QUARTZ CUBES REFLECT BACK TO THE SOURCE THE HIGH-ENERGY SHORT-DURATION PULSES FIRED BY THE GROUND LOCATED LASER TRACKING SYSTEMS. THE REFLECTED LIGHT IS PICKED UP BY A TELESCOPE AND THEN A DIGITAL COUNTER MEASURES THE ROUND-TRIP TRAVEL TIME OF THE LIGHT PULSES. THIS GIVES THE DISTANCE TO THE SATELLITE AND THUS FORMS THE BASIS OF THE SATELLITE OPTICAL LASER TRACKING SYSTEM. PHOTOGRAPHING THE REFLECTION AGAINST THE STAR-FIELD YIELDS ANGULAR POSITION.

32. PHENOMENA OBSERVED

HIGH-ENERGY SHORT-DURATION LASER PULSES FROM GROUND STATIONS

33. MEASUREMENT RANGE

34. PRECISION AND ACCURACY

RANGE MEASUREMENT TO 1.5 METERS; RANGE-RATE TO ABOUT 1 CM/SEC

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.45 TO 0.7 MICRON	NA	

38. FIELD OF VIEW	39. GROUND SWATH
80.0 DEG	900 NM DIAM CIRCLE FROM 600 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
.33 DEG	3.5 NM FROM 600 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED ECCENTRIC	HIGH RETROGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

400 PRISMS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
		NONE	NONE	NONE	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
NONE	NONE	NONE		

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
NONE	NONE	AS SCHEDULED

62. TELEMETRY REQUIREMENTS

NONE

63. ADVANTAGES AND LIMITATIONS

64. REFERENCES

1) NASA PRESS KIT FOR GEOS-B. RELEASE NO:68-2K, JAN 7, 68.***2) PLAN OF OPERATIONS FOR THE GEOS-B SPACECRAFT. REPORT NO. R-4035-45-2, COMMUNICATIONS AND SYSTEMS, INC., OCT 67.***3) PARAMETRIC ANALYSIS FOR FUTURE GEODETIC SPACECRAFT DEVELOPMENT. REPORT NO.: R-4035-50-2, COMMUNICATIONS AND SYSTEMS INC, JAN 68.

65. HISTORICAL REMARKS

ALSO FLOWN ON EXPLORERS 22, 27, AND 29. GEOS 2 = EXPLORER 36.

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
OPTICAL BEACON	OBEAC	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0003

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
BERBERT, J.H.	GODDARD SPACE FLT CENTER	
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					OPERATIONAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
ROSENBERG, J. D.	NASA HDQTRS	OSSA/SCG	202-963-3361

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
E. G. AND G., INC.	BEDFORD, MASS	01/68	NA

26. INSTRUMENT TYPE	27. SECUR TY
BEACON, FOUR HIGH-INTENSITY XENON-FLASH-TUBE	UNC

28. APPLICATION	29. SPACECRAFT
GEOD	GEOS 2

30. PURPOSE

PRIMARY-TO OBTAIN GEOMETRIC TRIANGULATION OF INTERVISIBLE POINTS ON THE EARTH'S SURFACE.***SECONDARY-TO OBTAIN PRECISE ANGLE MEASUREMENTS.

31. PRINCIPLES OF OPERATION

THE OPTICAL BEACONS ARE USED IN CONJUNCTION WITH A LARGE NUMBER OF GROUND-BASED CAMERA SYSTEMS WHICH SIMULTANEOUSLY PHOTOGRAPH THE BEACONS AGAINST A STAR BACKGROUND. THE BEACON SYSTEM CONSISTS OF 4 IDENTICAL HELICALLY-WOUND FLASH TUBES FILLED WITH XENON GAS. MAXIMUM LIGHT LEVELS AT GROUND STATIONS OCCUR WHEN THE SATELLITE IS SEEN BETWEEN 35 AND 55 DEG ELEVATION ANGLE. THIS BEACON SYSTEM WITH 4 LAMPS FLASHED SIMULTANEOUSLY IS SUITABLE FOR OPERATIONAL ALTITUDES UP TO 1000 NM. THE LIGHT OUTPUT IS 1580 CANDLE-SECONDS FOR EACH FLASH TUBE OR APPROXIMATELY 6300 CANDLE-SECS FOR ALL 4 TUBES FLASHING SIMULTANEOUSLY. THE NOMINAL FLASH DURATION IS 1 MILLISECOND BETWEEN 30% INTENSITY POINTS. IN TERMS OF POWER, BETWEEN 610 AND 950 INDIVIDUAL LAMP FLASHES PER DAY ARE AVAILABLE. THE ENERGY USED IN A SINGLE FLASH IS 720 WATT-SEC. EACH FLASH TUBE IS EXPECTED TO HAVE A FLASH INTENSITY OF AT LEAST 50% OF ITS INITIAL VALUE AFTER 40,000 FLASHES. THE PROGRAMMED FLASH TIMES AND NUMBER OF TUBES TO BE FLASHED ARE INJECTED INTO THE SATELLITE MEMORY, BY THE ROSMAN GROUND STATION, ON A DAILY BASIS.

32. PHENOMENA OBSERVED

NA

33. MEASUREMENT RANGE

34. PRECISION AND ACCURACY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
NA	NA	

38. FIELD OF VIEW	39. GROUND SWATH
NA	NA

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
NA	NA

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
NA		MED ECCENTRIC HIGH	RETROGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

FOUR FLASH TUBES, BATTERY

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
80 LB		8 WATTS		720 WATTS	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
NONE	NONE	NONE	NONE	NONE

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
NONE	NA	40 SEQUENCES/DAY

62. TELEMETRY REQUIREMENTS

NONE

63. ADVANTAGES AND LIMITATIONS

64. REFERENCES

1) NASA PRESS KIT FOR GEOS-B. RELEASE NO: 68-2K, JAN 7, 68.***2) PARAMETRIC ANALYSIS FOR FUTURE GEODETIC SPACECRAFT DEVELOPMENT. REPORT NO: R-4035-50-2, COMMUNICATIONS AND SYSTEMS INC. JAN 68.

65. HISTORICAL REMARKS

GEOS 2 IS ALSO KNOWN AS EXPLORER 36.

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
SATELLITE RANGE AND RANGE-RATE EXPERIMENT	SRARR	
(TITLE CONT.)	4. RESUME DATE: 11/10/69	5. VERSION: 0003

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
BERBERT, J. H.	GODDARD SPACE FLT CENTER	301-982-5055
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					OPERATIONAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
ROSENBERG, J. D.	NASA HDQTRS	OSSA/SCG	202-963-3361

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
GODDARD SPACE FLT CENTER	GREENBELT, MD.	01/68	NA

26. INSTRUMENT TYPE	27. SECURITY
TRANSPONDER, S-BAND 2271 MHZ (RECEIVE) AND 1705 MHZ (XMIT)	UNC

28. APPLICATION	29. SPACECRAFT
GEOD	GEOS 2

30. PURPOSE

PRIMARY-TO BE USED FOR TRACKING THE SATELLITE TO AUGMENT GEODETIC DATA.***SECONDARY-TO PROVIDE A COMPARISON OF THIS SYSTEM AND THE OTHER GEODETIC MEASUREMENT INSTRUMENTS ON BOARD.

31. PRINCIPLES OF OPERATION

THIS SYSTEM PROVIDES MEASUREMENT OF SLANT RANGE AND THE RATE OF CHANGE OF SLANT RANGE OF THE SPACECRAFT. THE RANGE IS OBTAINED BY MEASURING THE PHASE SHIFT OF A WAVE TRAVELLING FROM THE GROUND TRANSMITTER TO THE SATELLITE AND BACK. RANGE RATE IS MEASURED BY DETERMINING THE DOPPLER-SHIFT EFFECT ON SEVERAL MODULATION FREQUENCIES. THE TRANSPONDER RECEIVES SIMULTANEOUS SIGNALS FROM ONE TO THREE GROUND STATIONS AT 2271 MHZ, MODULATED BY THE RANGING SIDETONES. THE TRANSPONDER TRANSLATES THESE SIGNALS INTO THE LOWER CARRIER FREQUENCY (1705 MHZ), WHILE PRESERVING THE COHERENCE OF THE RANGE TONE MODULATION. THE COHERENCE IS PRESERVED BY USING THE SAME OFFSET OSCILLATOR AS A SOURCE FOR THE BASIC FREQUENCY FOR THE DOWN-CARRIER, AND AS A HETERODYNE SOURCE FOR THE UP-CARRIER. NO DEMODULATION OF THE RANGING TONES TAKES PLACE WITH THE UP-CARRIER. THE POWER SUPPLY UNIT IS SHARED WITH THE SECOR AND C-BAND TRANSPONDERS AND CAN SUPPLY POWER TO EACH TRANSPONDER FOR APPROXIMATELY 60 MINUTES PER DAY, ON COMMAND.

32. PHENOMENA OBSERVED

2271 MHZ (S-BAND) RADIO TRANSMISSIONS FROM GROUND STATIONS

33. MEASUREMENT RANGE

NA

34. PRECISION AND ACCURACY

ACCURACY OF RANGE MEASUREMENT IS APPROXIMATELY 10 METERS

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
SEE ITEM 31	NA	

38. FIELD OF VIEW	39. GROUND SWATH

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
	NA

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
NA	NA	MED ECCENTRIC	HIGH RETROGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

TRANSPONDER

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
8 LB			5 WATTS	25 WATTS	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
SOURC/SEN				

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
NONE	REALTIME TELEMETRY	30 MIN PER DAY

62. TELEMETRY REQUIREMENTS

SEE ITEM 31

63. ADVANTAGES AND LIMITATIONS

RANGE SIGNAL MARGIN (27 DB AT 900 NM SLANT RANGE) IS SLIGHTLY LOWER THAN SECOR.

64. REFERENCES

1) NASA PRESS KIT FOR GEOS-B. RELEASE NO: 68-2K, JAN 7, 68.***2) PARAMETRIC ANALYSIS FOR FUTURE GEODETIC SPACECRAFT DEVELOPMENT. COMMUNICATIONS AND SYSTEMS, INC, REPORT NO. R-4035-50-2, JAN 68. ***3) PLANNED OPERATIONS FOR THE GEOS-B SPACECRAFT. COMMUNICATIONS AND SYSTEMS, INC, REPORT NO. R-4035-45-2, OCT 1967.

65. HISTORICAL REMARKS

ALSO FLOWN ON GEOS 1. GEOS 2 IS ALSO KNOWN AS EXPLORER 36.

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
SEQUENTIAL COLLATION OF RANGE SYSTEM	SECOR	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
MCCALL, J.	CORPS OF ENGINEERS	
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					OPERATIONAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
ROSENBERG, J. D.	NASA HDQTRS	OSSA/SCG	202-963-3361

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
CUBIC CORPORATION	SAN DIEGO, CAL	01/68	NA

26. INSTRUMENT TYPE	27. SECURITY
TRANSPONDER, RANGING	UNC

28. APPLICATION	29. SPACECRAFT
GEOD	GEOS 2

30. PURPOSE

PRIMARY-TO DETERMINE POSITIONS BY GEOMETRIC MEANS IN A STEP BY STEP FASHION, AND TO EXTEND A GEOMETRIC SURVEY AROUND THE EARTH.

31. PRINCIPLES OF OPERATION

THE RANGE TRANSPONDER FLOWN ON GEOS 1, AS WELL AS GEOS 2, IS USED IN CONJUNCTION WITH THE ARMY SECOR (SEQUENTIAL COLLATION OF RANGE) SYSTEM. FOUR GROUND STATIONS INTERROGATE THE SATELLITE IN TURN FOR RANGING TO THE SPACECRAFT TRANSPONDER. RANGE MEASUREMENTS ARE MADE BY MEASURING THE PHASE SHIFT OF THE RANGING SIDETONES WHICH MODULATE THE CW CARRIER. BY USING GEOMETRIC TECHNIQUES THE UNKNOWN POSITION OF 1 OF 4 STATIONS CAN BE ACCURATELY DETERMINED. A SEQUENCE OF 4 INTERROGATIONS, 1 FROM EACH STATION, IS ACCOMPLISHED IN 50 MILLESEC; THESE SEQUENCES CAN BE REPEATED AT A RATE OF 20 A SECOND. IN OPERATION, THE TRANSPONDER RECEIVES AN INTERROGATING SIGNAL (421 MHZ), REMOVES THE FM RANGING FREQUENCIES FROM THE CARRIER AND LOCALLY GENERATES TWO COHERENT REPLY CARRIERS, MODULATING ONE (449 MHZ) WITH ALL THE FM RANGING FREQUENCIES AND THE OTHER (224.5 MHZ) WITH ONLY THE 585.533 KHZ RANGING FREQUENCY. THE SECOND CARRIER ALLOWS A CORRECTION TO BE MADE FOR IONOSPHERIC REFRACTION EFFECTS. THE SECOR TRANSPONDER IS OPERATED FROM A POWER SUPPLY IT SHARES WITH THE SRARR AND C-BAND TRANSPONDERS.

32. PHENOMENA OBSERVED

RF TRANSMISSION FROM GROUND STATIONS AT 421 MHZ

33. MEASUREMENT RANGE

34. PRECISION AND ACCURACY

ACCURACY OF RANGE MEASUREMENT IS APPROXIMATELY 10 METERS

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
SEE ITEM 31	NA	

38. FIELD OF VIEW	39. GROUND SWATH
NA	

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
NA	NA

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
NA	NA	MED ECCENTRIC	HIGH RETROGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

TRANSPONDER

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
11 LB			1 WATT	30 WATTS	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
SOURC/SEN				

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
NONE	REALTIME TELEMETRY	30 MINUTES PER DAY

62. TELEMETRY REQUIREMENTS

SEE ITEM 31

63. ADVANTAGES AND LIMITATIONS

LOCATION ERRORS ARE ADDITIVE AS GROUND STATIONS MOVE.

64. REFERENCES

1) NASA PRESS KIT FOR GEOS-B. RELEASE NO: 68-2K, JAN 7, 68.***2) PARAMETRIC ANALYSIS FOR FUTURE GEODETIC SPACECRAFT DEVELOPMENT. COMMUNICATIONS AND SYSTEMS, INC, REPORT NO. R-4035-50-2, JAN 68. ***3) PLAN OF OPERATIONS FOR THE GEOS-B SPACECRAFT. COMMUNICATIONS AND SYSTEMS, INC, REPORT NO. R-4035-45-2, OCT 1967.

65. HISTORICAL REMARKS

GEOS 2 IS ALSO KNOWN AS EXPLORER 36.

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
SOLAR-SCIENCE ELECTRON FLUX EXPERIMENT	SSEFE	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
ELECTRON COUNTER	11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
BOSTROM, C.O.	APL-JOHNS HOPKINS UNIV	301-776-7100
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					OPERATIONAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
ROSENBERG, J. D.	NASA HDQTRS	OSSA/SCG	202-963-3361

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
APL-JOHNS HOPKINS UNIV	SILVER SPRING, MD.	01/68	NA

26. INSTRUMENT TYPE	27. SECURITY
COUNTER, ELECTRON MULTIPLIER PARTICLE; X-AXIS MAGNETOMETER	UNC

28. APPLICATION	29. SPACECRAFT
PART-FLD	GEOS 2

30. PURPOSE

PRIMARY-TO MEASURE THE FLUX OF PRECIPITATING ELECTRONS IN THE EARTH'S ATMOSPHERE.

31. PRINCIPLES OF OPERATION

THE SOLAR SCIENCE ELECTRON DETECTOR (SSED) IS AN INSTRUMENT TO MEASURE THE FLUX OF PRECIPITATING ELECTRONS USING ELECTROSTATIC FOCUSING TO DEFINE THE ENERGY INTERVAL AND AN ELECTRON MULTIPLIER (BENDIX CHANNELTRON) AS A PARTICLE DETECTOR. THE MAGNETIC PHENOMENA ARE MEASURED WITH THE X-AXIS MAGNETOMETER. THE OUTPUT IS FILTERED AND AMPLIFIED BY A FACTOR OF 100. THE HALF-POWER POINTS ON THE FILTER ARE AT 0.03 HZ AND 3 HZ. AFTER AMPLIFICATION THE FULL SCALE TELEMETRY READING IS +- 500 GAMMA WITH A SENSITIVITY OF 5 GAMMA. THE PARTICLE AND MAGNETOMETER DATA ARE SUBCOMMUTATED WITHIN THE SSED PACKAGE SO THAT ONLY ONE CHANNEL OF SATELLITE ANALOG TELEMETRY IS USED. THE 2 OUTPUTS ARE SAMPLED ALTERNATELY AS PROGRAMMED. PARTICLE DATA ARE OBTAINED ONLY ON PASSES WITHIN VIEW OF THE APL COMMAND STATION. SINCE THE SPACECRAFT IS STABILIZED TO WITHIN ABOUT 20 DEG OF ZENITH AND THE INSTRUMENT COLLIMATOR ADMITS ONLY PARTICLES WITHIN ABOUT 13 DEG OF THE AXIS, PARTICLES WITH LOCAL PITCH ANGLES BETWEEN 0 AND 33 DEG WILL BE SAMPLED.

32. PHENOMENA OBSERVED

PRECIPITATING ELECTRONS WITH LOCAL PITCH ANGLES FROM 0 TO 33 DEG

33. MEASUREMENT RANGE

FLUX FROM 10 THOUSAND TO 10 BILLION ELECTRONS/SEC/SQ CM/STER

34. PRECISION AND ACCURACY

MAGNETIC PHENOMENA TO PLUS OR MINUS 5 GAMMA

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
4. TO 13. KEV	NA	

38. FIELD OF VIEW	39. GROUND SWATH
33. DEG	NA

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
33. DEG	NA

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED ECCENTRIC	HIGH RETROGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

ELECTRON MULTIPLIER, X-AXIS MAGNETOMETER

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
	SENSITIVE	SENSITIVE		

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
	DELAYED TELEMETRY	AS PROGRAMMED

62. TELEMETRY REQUIREMENTS

63. ADVANTAGES AND LIMITATIONS

ELECTRON SHEATH NEAR SPACECRAFT INTERFERES WITH EXP.

64. REFERENCES

1) NASA PRESS KIT FOR GEOS-B. RELEASE NO: 68-2K, JAN 7, 68.***2) PLAN OF OPERATIONS FOR THE GEOS-B SPACECRAFT. REPORT NO. R-4035-45-2. COMMUNICATIONS AND SYSTEMS INC., OCT. 1967.

65. HISTORICAL REMARKS

GEOS 2 IS ALSO KNOWN AS EXPLORER 36.

66. DIAGRAMS

ITOS A

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
FLAT-PLATE RADIOMETER	FPR	
(TITLE CONT.)	4. RESUME DATE: 11/10/69	5. VERSION: 0006

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
PARENT, DR. R.J.	UNIVERSITY OF WISCONSIN	608-262-5938
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					INTEGRATION

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GARBACZ, M. L.	NASA HDQTRS	OSSA/SRO	202-963-4291

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
UNIVERSITY OF WISCONSIN	MADISON, WISCONSIN		NA

26. INSTRUMENT TYPE	27. SECURITY
RADIOMETER, IR/VISIBLE LOW-RESOLUTION THERMISTER BOLOMETER	UNC

28. APPLICATION	29. SPACECRAFT
MET	ITOS A

30. PURPOSE

PRIMARY-TO GATHER DATA TO AID IN DETERMINING: (1) THE GEOGRAPHIC DISTRIBUTION OF ENERGY RADIATED FROM THE EARTH AND THE RELATIONSHIP OF THIS ENERGY TO INCOMING ENERGY FROM THE SUN AND (2) THE REFLECTION AND SCATTERING OF SOLAR RADIATION BY THE EARTH-ATMOSPHERE SYSTEM.

31. PRINCIPLES OF OPERATION

AN IDENTICAL[5] FLAT PLATE RADIOMETER (FPR), WILL ALSO BE FLOWN ON ITOS B AND C AND HAS FLOWN ON TIROS M. THE PRINCIPAL PART OF EACH RADIOMETER IS A THIN ALUMINUM DISK, THE TEMPERATURE OF WHICH IS SENSED BY THERMISTORS MOUNTED ON THE BACK SURFACE. THE HOUSING TEMPERATURES ARE SEPARATELY SENSED AND RECORDED. THERE ARE 2 PAIRS OF SENSORS. ONE DISK OF EACH PAIR IS PAINTED BLACK AND ONE IS ANODIZED ALUMINUM. THE BLACK PAINTED SURFACE WILL RESPOND TO THE SUM OF THE REFLECTED SOLAR, DIRECT SOLAR, AND RE-RADIATED LONG-WAVE RADIATION. THE ANODIZED ALUMINUM (WHITE) DISKS REFLECT IN THE VISIBLE RANGE BUT ARE BLACK TO IR BEYOND 7 MICRONS. THESE ABSORB THE RERADIATED ENERGY FROM THE EARTH AND EXCLUDE TO A HIGH DEGREE THE DIRECT AND REFLECTED SOLAR RADIATION. ONE BLACK/WHITE PAIR WILL OPERATE AS RADIATIVE EQUILIBRIUM DETECTORS, SIMILAR TO ESSA. THE 2ND PAIR IS OF A NEW THERMAL FEEDBACK DESIGN. THE ENERGY REQUIRED TO MAINTAIN A CONSTANT TEMPERATURE WILL BE MEASURED. THE SET OF 4 RADIOMETERS ARE MOUNTED BETWEEN THE 2 SCANNING RADIOMETERS AND POINT TO THE NADIR. THE FIELD OF VIEW IS 180 DEGREES FOR ALL FOUR SENSORS.

32. PHENOMENA OBSERVED

ENERGY RADIATED FROM AND REFLECTED BY THE EARTH'S ATMOSPHERE

33. MEASUREMENT RANGE

34. PRECISION AND ACCURACY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.3 TO 30.0 MICRON		

38. FIELD OF VIEW	39. GROUND SWATH
SEE ITEM 31	LIMB-TO-LIMB (3500 NM) FROM 500 NM ALT

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED CIRCULAR	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

4 SENSORS (THERMISTORS), ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
		SENSITIVE	SENSITIVE	FPR THERMALLY ISOLATED

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
VIEW OF HOUSING	DELAYED TELEMETRY	CONTINUOUS

62. TELEMETRY REQUIREMENTS

15 WORDS CONSTITUTE ONE FPR FRAME OF DATA, 8 BITS TO THE WORD. THE FRAME IS READ OUT SERIALLY AT 15 BPS DATA READOUT TAKING 8 SEC. DATA SAMPLING CYCLE TAKES 32 SEC.

63. ADVANTAGES AND LIMITATIONS

64. REFERENCES

1) DESIGN STUDY REPORT FOR THE IMPROVED TOS(ITOS) SYSTEM, V.1,2. RCA ASTRO-ELECTRONICS, CONTRACT NO. NAS5-9034, JUNE 7, 1968.***
2) RUBIN, L.: OPERATIONAL PROCESSING OF LOW RESOLUTION IR (LRIR) DATA FROM ESSA SATELLITES. ESSA TECH REPORT NESC-42, FEB. 1968.

65. HISTORICAL REMARKS

THIS FPR IS SIMILAR TO THE LRIR FLOWN ON ESSA 3, 5, 7, AND 9.

66. DIAGRAMS

ITOS B

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
FLAT-PLATE RADIOMETER	FPR	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0006

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
PARENT, DR. R.J.	UNIVERSITY OF WISCONSIN	608-262-5938
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					FLT MODEL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GARBACZ, M.L.	NASA HDQTRS	OSSA/SRO	202-963-4291

22. VENDOR	23 LOCATION	24. FLIGHT DATE	25. LEAD TIME
UNIVERSITY OF WISCONSIN	MADISON, WISCONSIN		

26. INSTRUMENT TYPE	27. SECURITY
RADIOMETER, IR/VISIBLE LOW-RESOLUTION THERMISTOR BOLOMETER	UNC

28. APPLICATION	29. SPACECRAFT
MET	ITOS B

30. PURPOSE

PRIMARY-TO GATHER DATA TO AID IN DETERMINING: (1) THE GEOGRAPHIC DISTRIBUTION OF ENERGY RADIATED FROM THE EARTH AND THE RELATIONSHIP OF THIS ENERGY TO INCOMING ENERGY FROM THE SUN AND (2) THE REFLECTION AND SCATTERING OF SOLAR RADIATION BY THE EARTH-ATMOSPHERE SYSTEM.

31. PRINCIPLES OF OPERATION

AN IDENTICAL FLAT PLATE RADIOMETER (FPR), WILL ALSO BE FLOWN ON ITOS A AND C AND HAS FLOWN ON TIROS M. THE PRINCIPAL PART OF EACH RADIOMETER IS A THIN ALUMINUM DISK, THE TEMPERATURE OF WHICH IS SENSED BY THERMISTORS MOUNTED ON THE BACK SURFACE. THE HOUSING TEMPERATURES ARE SEPARATELY SENSED AND RECORDED. THERE ARE 2 PAIRS OF SENSORS. ONE DISK OF EACH PAIR IS PAINTED BLACK AND ONE IS ANODIZED ALUMINUM. THE BLACK PAINTED SURFACE WILL RESPOND TO THE SUM OF THE REFLECTED SOLAR, DIRECT SOLAR, AND RE-RADIATED LONG-WAVE RADIATION. THE ANODIZED ALUMINUM (WHITE) DISKS REFLECT IN THE VISIBLE RANGE BUT ARE BLACK TO IR BEYOND 7 MICRONS. THESE ABSORB THE RERADIATED ENERGY FROM THE EARTH AND EXCLUDE TO A HIGH DEGREE THE DIRECT AND REFLECTED SOLAR RADIATION. ONE BLACK/WHITE PAIR WILL OPERATE AS RADIATIVE EQUILIBRIUM DETECTORS, SIMILAR TO ESSA. THE 2ND PAIR IS OF A NEW THERMAL FEEDBACK DESIGN. THE ENERGY REQUIRED TO MAINTAIN A CONSTANT TEMPERATURE WILL BE MEASURED. THE SET OF 4 RADIOMETERS ARE MOUNTED BETWEEN THE 2 SCANNING RADIOMETERS AND POINT TO THE NADIR. THE FIELD OF VIEW IS 180 DEGREES FOR ALL FOUR SENSORS.

32. PHENOMENA OBSERVED

ENERGY RADIATED FROM AND REFLECTED BY THE EARTH'S ATMOSPHERE

33. MEASUREMENT RANGE

34. PRECISION AND ACCURACY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.3 TO 30.0 MICRON		

38. FIELD OF VIEW	39. GROUND SWATH
SEE ITEM 31	LIMB-TO-LIMB (3500 NM) FROM 500 NM ALT

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED CIRCULAR	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

4 SENSORS (THERMISTORS), ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
		SENSITIVE	SENSITIVE	FPR THERMALLY ISOLATED

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
VIEW OF HOUSING	DELAYED TELEMETRY	CONTINUOUS

62. TELEMETRY REQUIREMENTS

15 WORDS CONSTITUTE ONE FPR FRAME OF DATA, 8 BITS TO THE WORD. THE FRAME IS READ OUT SERIALLY AT 15 BPS DATA READOUT TAKING 8 SEC. DATA SAMPLING CYCLE TAKES 32 SEC.

63. ADVANTAGES AND LIMITATIONS

64. REFERENCES

1) DESIGN STUDY REPORT FOR THE IMPROVED TOS (ITOS) SYSTEM, V.1,2. RCA ASTRO-ELECTRONICS, CONTRACT NO. NAS5-9034, JUNE 7, 1968.***
2) RUBIN, L.: OPERATIONAL PROCESSING OF LOW RESOLUTION IR (LRIR) DATA FROM ESSA SATELLITES. ESSA TECH REPORT NESC-42, FEB. 1968.

65. HISTORICAL REMARKS

THIS FPR IS SIMILAR TO THE LRIR FLOWN ON ESSA 3, 5, 7, AND 9.

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
FLAT-PLATE RADIOMETER	FPR	
(TITLE CONT.)	4. RESUME DATE: 11/10/69	5. VERSION: 0006

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
PARENT, DR. R.J.	UNIVERSITY OF WISCONSIN	608-262-5938
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					FLT MODEL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GARBACZ, M. L.	NASA HDQTRS	OSSA/SRO	202-963-4291

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
UNIVERSITY OF WISCONSIN	MADISON, WISCONSIN		

26. INSTRUMENT TYPE	27. SECURITY
RADIOMETER, IR/VISIBLE LOW-RESOLUTION THERMISTOR BOLOMETER	UNC

28. APPLICATION	29. SPACECRAFT
MET	ITOS C

30. PURPOSE

PRIMARY-TO GATHER DATA TO AID IN DETERMINING: (1) THE GEOGRAPHIC DISTRIBUTION OF ENERGY RADIATED FROM THE EARTH AND THE RELATIONSHIP OF THIS ENERGY TO INCOMING ENERGY FROM THE SUN AND (2) THE REFLECTION AND SCATTERING OF SOLAR RADIATION BY THE EARTH-ATMOSPHERE SYSTEM.

31. PRINCIPLES OF OPERATION

AN IDENTICAL FLAT PLATE RADIOMETER (FPR), WILL ALSO BE FLOWN ON ITOSA AND B AND HAS FLOWN ON TIROS M. THE PRINCIPAL PART OF EACH RADIOMETER IS A THIN ALUMINUM DISK, THE TEMPERATURE OF WHICH IS SENSED BY THERMISTORS MOUNTED ON THE BACK SURFACE. THE HOUSING TEMPERATURES ARE SEPARATELY SENSED AND RECORDED. THERE ARE 2 PAIRS OF SENSORS. ONE DISK OF EACH PAIR IS PAINTED BLACK AND ONE IS ANODIZED ALUMINUM. THE BLACK PAINTED SURFACE WILL RESPOND TO THE SUM OF THE REFLECTED SOLAR, DIRECT SOLAR, AND RE-RADIATED LONG-WAVE RADIATION. THE ANODIZED ALUMINUM (WHITE) DISKS REFLECT IN THE VISIBLE RANGE BUT ARE BLACK TO IR BEYOND 7 MICRONS. THESE ABSORB THE RERADIATED ENERGY FROM THE EARTH AND EXCLUDE TO A HIGH DEGREE THE DIRECT AND REFLECTED SOLAR RADIATION. ONE BLACK/WHITE PAIR WILL OPERATE AS RADIATIVE EQUILIBRIUM DETECTORS, SIMILAR TO ESSA. THE 2ND PAIR IS OF A NEW THERMAL FEEDBACK DESIGN. THE ENERGY REQUIRED TO MAINTAIN A CONSTANT TEMPERATURE WILL BE MEASURED. THE SET OF 4 RADIOMETERS ARE MOUNTED BETWEEN THE 2 SCANNING RADIOMETERS AND POINT TO THE NADIR. THE FIELD OF VIEW IS 180 DEGREES FOR ALL FOUR SENSORS.

32. PHENOMENA OBSERVED

ENERGY RADIATED FROM AND REFLECTED BY THE EARTH'S ATMOSPHERE

33. MEASUREMENT RANGE

34. PRECISION AND ACCURACY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.3 TO 30.0 MICRON		

38. FIELD OF VIEW	39. GROUND SWATH
SEE ITEM 31	LIMB-TO-LIMB (3500 NM) FROM 500 NM ALT

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED CIRCULAR	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

4 SENSORS (THERMISTORS), ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
		SENSITIVE	SENSITIVE	FPR THERMALLY ISOLATED

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
VIEW OF HOUSING	DELAYED TELEMETRY	CONTINUOUS

62. TELEMETRY REQUIREMENTS

15 WORDS CONSTITUTE ONE FPR FRAME OF DATA, 8 BITS TO THE WORD. THE FRAME IS READ OUT SERIALLY AT 15 BPS DATA READOUT TAKING 8 SEC. DATA SAMPLING CYCLE TAKES 32 SEC.

63. ADVANTAGES AND LIMITATIONS

64. REFERENCES

1) DESIGN STUDY REPORT FOR THE IMPROVED TOS (ITOS) SYSTEM, V.1,2. RCA ASTRO-ELECTRONICS, CONTRACT NO. NAS5-9034, JUNE 7, 1968.***
2) RUBIN, L.: OPERATIONAL PROCESSING OF LOW RESOLUTION IR (LRIR) DATA FROM ESSA SATELLITES. ESSA TECH REPORT NESC-42, FEB. 1968.

65. HISTORICAL REMARKS

THIS FPR IS SIMILAR TO THE LRIR FLOWN ON ESSA 3, 5, 7, AND 9.

66. DIAGRAMS

NIMBUS 1

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
ADVANCED VIDICON CAMERA SYSTEM	AVCS	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
BEBRIS, J.	GODDARD SPACE FLT CENTER	617-494-2532
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
PRESS, H.	GODDARD SPACE FLT CENTER	301-982-6142

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					POST FLIGHT

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B. B.	NASA HDQTRS	OSSA/SRN	202-962-0891

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
RCA ASTRO-ELECTRONICS	PRINCETON, N.J.	08/64	NA

26. INSTRUMENT TYPE	27. SECURITY
IMAGER, 1-INCH WIDE-ANGLE HIGH-RESOLUTION VIDICON	UNC

28. APPLICATION	29. SPACECRAFT
MET, EBSP	NIMBUS 1

30. PURPOSE

PRIMARY-TO OBSERVE THE ENTIRE DAYTIME CLOUD COVER OF THE EARTH ONCE A DAY FOR METEOROLOGICAL RESEARCH PURPOSES. ***SECONDARY-TO TEST THE SYSTEM IN SPACE PRIOR TO APPLICATION IN AN OPERATIONAL SPACECRAFT SYSTEM.

31. PRINCIPLES OF OPERATION

THE AVCS TEST FLOWN ON NIMBUS 1 AND 2 AND OPERATIONALLY ON ESSA 3 AND 5 ARE SIMILAR EXCEPT FOR THE LENS USED AND NIMBUS HAVING 3 CAMERAS TO ESSA'S 2. ON NIMBUS THE 3 VIDICON CAMERAS ARE DEPLOYED IN A FAN-LIKE ARRAY TO PRODUCE A 3-SEGMENT COMPOSITE PICTURE. EACH CAMERA COVERS A 37-DEG FOV WITH THE CENTER CAMERA POINTING STRAIGHT DOWN. THE OPTICAL AXIS OF THE OTHER 2 UNITS ARE ROTATED 35 DEG TO EITHER SIDE OF LOCAL VERTICAL. A 3-PICTURE SET IS TAKEN EVERY 91 SECS AND COVERS AN AREA OF APPROX 400,000 SQ MI WITH 96 PICTURES PER ORBIT ACQUIRED. THE PICKUP TUBES ARE 833 SCANLINE, 1-IN DIAM VIDICONS GIVING A LINEAR RESOLUTION OF ABOUT 0.5 NM AT THE OPTICAL CENTER AT 575 NM ALT. EACH OF THE 3 CAMERAS EMPLOY A 17 MM F/4 LENS WITH A SERVOCONTROLLED IRIS FOR EXPOSURE ADJUSTMENT. SHUTTER SPEED IS SET AT 40 MILLISEC EXPOSURE TIME. A POTENTIOMETER ATTACHED TO THE SOLAR ARRAY CONTROLS THE LENS OPENING FROM F/16 WHEN THE SPACECRAFT IS OVER THE EQUATOR TO F/4 WHEN THE S/C IS NEAR THE POLES. THE CAMERAS ARE PROGRAMMED TO OPERATE ONLY AT A SUN ANGLE OF HIGHER THAN 85 DEG. A TAPE RECORDER WITH 1200 FT OF TAPE WILL RECORD 2 COMPLETE ORBITS OF 192 PICTURES. THESE VIDEO SIGNALS ARE TRANSMITTED TO THE GROUND IN 4 MIN USING THE 1707.5 MHZ TRANSMITTER

32. PHENOMENA OBSERVED

CLOUD COVER OVER THE EARTH'S SURFACE

33. MEASUREMENT RANGE

DYNAMIC RANGE OF 14 TO 11400 FOOT-LAMBERTS

34. PRECISION AND ACCURACY

8-10 LEVELS OF GRAY, 833 LINE RESOLUTION

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.45 TO 0.65 MICRON	NA	

38. FIELD OF VIEW	39. GROUND SWATH
37.5 DEG	400 NM DIAM CIRCLE FROM 600 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.05 DEG	0.5 NM AT CENTER FROM 575 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED CIRCULAR	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

3 VIDICON CAMERAS, ASSOCIATED ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
63 LB		27 WATTS			12 MON

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
SENSITIVE				MAGNETIC SHIELDING USED

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
GRAY-SCALE CALIBRATOR	DELAYED TELEMETRY	CONTINUOUS DAYTIME

62. TELEMETRY REQUIREMENTS

NIMBUS S-BAND TRANSMITTER USED TO TRANSMIT VIDEO SIGNAL TO GROUND STATION USING THE 1707.5 MHZ FREQUENCY.

63. ADVANTAGES AND LIMITATIONS

64. REFERENCES

1) SIG ACHIEV IN SAT MET 1958-1965, NASA SP-96.***2) INSTRUMENTS AND SPACECRAFT OCT 57-MAR 65, NASA SP-3028.***3) NIMBUS I USER'S CATALOG: AVCS AND APT 1965, GSFC.***4) OSTROW,H.: REVIEW OF A DECADE OF SPACE CAMERA SYSTEMS DEVELOP FOR MET. 13TH ANNUAL TECH SYMP SOC PHOTO-OPTICAL ENGR. WASH.D.C. 19-23 AUG. 68.***5) DATA AVAILABLE FROM NATIONAL WEATHER RECORDS CTR (ESSA) ASHEVILLE,N.C.

65. HISTORICAL REMARKS

SIMILAR TO AVCS ON NIMBUS 2, ESSA 3, AND ESSA 5.

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
AUTOMATIC PICTURE-TRANSMISSION SYSTEM	APT	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
STAMPFL, DR. R.A.	GODDARD SPACE FLT CENTER	301-982-6163
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					POST FLIGHT

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B. B.	NASA HDQTRS	OSSA/SRN	202-962-0891

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
RCA ASTRO-ELECTRONICS	PRINCETON, N.J.	08/64	NA

26. INSTRUMENT TYPE	27. SECURITY
IMAGER, 1-INCH AUTOMATIC-PICTURE-TRANSMISSION VIDICON	UNC

28. APPLICATION	29. SPACECRAFT
MET	NIMBUS 1

30. PURPOSE

PRIMARY-TO PROVIDE REAL-TIME WIDE-ANGLE CLOUD COVER PICTURES FOR USE BY LOCAL USERS.***SECONDARY-CHECKOUT FOR SENSORS TO BE USED IN FUTURE OPERATIONAL TOS FLIGHTS.

31. PRINCIPLES OF OPERATION

THE APT SYSTEM, CONSISTING OF A 1-IN VIDICON ARRANGEMENT, WAS TEST FLOWN ON TIROS 8 AND NIMBUS 1 AND 2 (1 CAMERA), PRIOR TO OPERATIONAL TOS FLIGHTS (ESSA 2,4,6) AND TIROS M (2 CAMERAS). THE VIDICON USED INITIALLY (TIROS 8 AND NIMBUS 1), HAD A DIELECTRIC LAYER DEPOSITED ON THE GUN SIDE OF THE PHOTOCONDUCTOR TO STORE THE SCENE INFORMATION. HOWEVER, SINCE THE ELECTRON BEAM ALTERED THE ELECTRIC PROPERTIES OF THIS SURFACE, THE VIDICON WAS UPGRADED FOR FUTURE FLIGHTS. THE CAMERA UTILIZES A TEGEA-KINOPTIC, 108-DEG, WIDE ANGLE, F/1.8 OBJECTIVE LENS WITH A 5.7 MM FL. THE SYSTEM AUTOMATICALLY TAKES AND TRANSMITS A PICTURE EVERY 208 SECS WHILE THE SATELLITE IS IN DAYLIGHT. OPTICAL EXPOSURE TIME IS 40 MILLISEC, GIVING SMEAR OF LESS THAN 10 PERCENT OF ONE PICTURE ELEMENT. AN 8-SECOND TURN-ON AND SYNC-SIGNAL PRECEDES THE 200 SECOND TRANSMISSION, AT WHICH TIME THE VIDICON IS SCANNED AT 4 LINES PER SEC, PRODUCING AN 800-LINE PICTURE WITH SCAN LINES PERPENDICULAR TO THE ORBIT TRACK. A 5-WATT TV TRANSMITTER BROADCASTS THE SIGNAL IN THE 136.95 MHZ BAND. AN APT GROUND STATION WITH AN APPROPRIATE ANTENNA, RECEIVER, AND A RECORDER CAN RECEIVE THESE PICTURES WHEN THE SPACECRAFT IS WITHIN ACQUISITION RANGE. APT IS COMPATIBLE WITH COMMERCIAL 240 RPM FAX EQUIPMENT.

32. PHENOMENA OBSERVED

CLOUD AND TERRAIN FEATURES OF APPROX 1.7 NM OR LARGER

33. MEASUREMENT RANGE

DYNAMIC PICTURE RANGE OF 10:1

34. PRECISION AND ACCURACY

6 TO 10 LEVELS OF BRIGHTNESS VARIATION

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.45 TO 0.65 MICRON	NA	

38. FIELD OF VIEW	39. GROUND SWATH
89.0 BY 89.0 DEG	925 BY 925 NM FROM 600 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.162 DEG	APPROXIMATELY 1.7 NM FROM 600 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
1.0 DEG	0.1 DEG/SEC	MED ECCENTRIC	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

VIDICON, ELECTRONICS, TRANSMITTER, TAPE RECORDER

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
30 LB				40 WATTS	200 HRS

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
SENSITIVE	SENSITIVE			MAGNETIC SHIELDING USED

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
FIDUCIAL MARKS INCLUDED	REALTIME TELEMETRY	CONTINUOUS DAYTIME

62. TELEMETRY REQUIREMENTS

PICTURE IS COMMUNICATED TO AN EARTH STATION IN THE SPACE RES. BAND OF 136-137 MHZ. THE VIDEO OUTPUT REQUIRES 4000 HZ MAXIMUM FREQUENCY CAPABILITY.

63. ADVANTAGES AND LIMITATIONS

DIRECT TRANSMISSION ON COMMAND TO MANY RECEIVERS WITHOUT INTERMEDIATE STORAGE. DIELECTRIC SURFACE OF VIDICON LIMITED TUBELIFE.

64. REFERENCES

1) SIG ACHIEV IN SAT MET 1958-1964. NASA SP-96.***2) STAMPFL,R.A. AND STROUD, W.G.: THE APT TV CAMERA SYSTEM FOR MET SATS, JOURNAL SMPTE, VOL 73, FEB 1969.***3) OSTROW, H. AND WEINSTEIN, O.: REVIEW OF A DECADE OF SPACE CAMERA SYSTEMS DEVELOPMENT FOR METEOROLOGY. PRESENTED AT 13TH ANNUAL TECH SYMP OF SPIE, AUG 1968. ***4) BALAKRISHNAN:ADV IN COMM SYSTEMS, VOL 1, CHAPTER 5,STAMPFL.

65. HISTORICAL REMARKS

SIMILAR TO APT ON NIMBUS 2;ESSA 2,4,6;TIROS 8; SCHED FOR TIROS M

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
HIGH-RESOLUTION INFRARED RADIOMETER	HRIR	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
FOSHEE, L.L.	GODDARD SPACE FLT CENTER	
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					POST FLIGHT

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B. B.	NASA HDQTRS	OSSA/SRN	202-962-0891

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
ITT INDUSTRIAL LABS	FORT WAYNE, INDIANA	08/64	

26. INSTRUMENT TYPE	27. SECURITY
RADIOMETER, SINGLE-CHANNEL SCANNING INFRARED	UNC

28. APPLICATION	29. SPACECRAFT
MET, ERSP	NIMBUS 1

30. PURPOSE

PRIMARY-TO MAP THE EARTH'S CLOUD COVER AT NIGHT, THUS COMPLEMENTING THE TV COVERAGE DURING THE DAYTIME PORTION OF THE ORBIT. ***SECONDARY- TO MEASURE THE RADIATIVE TEMPERATURE OF CLOUD TOPS AND TERRAIN FEATURES.

31. PRINCIPLES OF OPERATION

THE SINGLE-CHANNEL SCANNING HRIR WAS FLOWN ON NIMBUS 1 AND 2. MODIFIED VERSIONS ARE SCHEDULED FOR FLIGHT ON NIMBUS B AND D. THE NIMBUS 1 HRIR CONTAINED A LEAD SELENIDE (PBSE) PHOTOCONDUCTIVE CELL WHICH IS RADIATION COOLED TO -75 DEGREES C AND OPERATES IN THE 3.4 TO 4.2 MICRON REGION. COOLING IS ACCOMPLISHED BY MEANS OF A BLACK COOLING PATCH AT THE BOTTOM OF A HIGHLY REFLECTIVE GOLD-COATED HORN. THE RADIOMETER HAS AN INSTANTANEOUS FOV OF 0.5 DEG, WHICH AT AN ALTITUDE OF 600 NM GIVES A GROUND RESOLUTION OF 5 NM. THE SCAN MIRROR IS INCLINED 45 DEGREES TO THE AXIS OF ROTATION AND CONTINUOUSLY ROTATES THE FIELD OF VIEW OF THE DETECTOR THROUGH 360 DEG IN A PLANE NORMAL TO THE SPACECRAFT VELOCITY. THE VIEW OF THE HOUSING AND SPACE DURING A ROTATION PROVIDE ZERO AND WARM BODY CALIBRATION POINTS. THE RADIATION REFLECTED FROM THE SCAN MIRROR IS CHOPPED AT 1.5 KHZ AT THE FOCUS OF A 4 INCH F/1 MODIFIED CASSEGRAINIAN TELESCOPE. IT IS THEN REFOCUSED AT THE DETECTOR BY RELAY MIRRORS WITH THE 3.4-4.2 MICRON WAVELENGTH FILTER BETWEEN THEM. THE SCAN RATE IS 44.7 RPM. THE OUTPUT SIGNAL HAS AN INFORMATION BANDWIDTH OF 280 HZ. THE INFORMATION IS STORED ON TAPE FOR PLAYBACK ON COMMAND.

32. PHENOMENA OBSERVED

EMITTED SURFACE RADIATION FROM 3.4 TO 4.2 MICRONS

33. MEASUREMENT RANGE

RADIANCE TEMPERATURE BETWEEN 210 AND 330 DEG K

34. PRECISION AND ACCURACY

NOISE EQUIV TEMP DIFF OF 1 K DEG FOR A 250-DEG K BACKGROUND

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
3.4 TO 4.2 MICRONS		

38. FIELD OF VIEW	39. GROUND SWATH
90. BY 0.5 DEG	1300 NM BY 5 NM FROM 600 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.5 DEG	5 NM FROM 600 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
1.0 DEG		MED CIRCULAR	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

RADIOMETER, RECORDER, ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
12 LB		4 WATTS		12 WATTS	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
SENSITIVE			SENSITIVE	

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
2 MEAS EACH 360 DEG SCAN	DELAYED TELEMETRY	NIGHTSIDE OF ORBIT

62. TELEMETRY REQUIREMENTS

THE SIGNAL IS RECTIFIED, RESULTING IN A DC OUTPUT VARYING FROM 0 TO -6 VOLTS AND HAVING A VIDEO BANDWIDTH OF 280 HZ.

63. ADVANTAGES AND LIMITATIONS

USEFUL DATA DURING NIGHTTIME; RF INTERFERENCE DEGRADED SOME SCANS, MOVING PARTS.

64. REFERENCES

1) NIMBUS HIGH RESOLUTION RADIATION DATA CATALOG AND USERS MANUAL V.1. GSFC, JAN. 65***2) SIG ACHIEV IN SPACE APPLICATIONS 1966. NASA SP-156, 1967.***3GOLDBERG, I.L.: METEOROLOGICAL IR INSTRUMENTS FOR SATELLITES. PRESENTED AT 13TH ANNUAL TECH SYMP OF SOC OF PHOTO-OPTICAL ENGR, AUG 23, 1967.***4) HRIR DATA AVAILABLE FROM: NIMBUS DATA, CODE 650, NASA SPACE SCIENCE DATA CTR, GSFC.

65. HISTORICAL REMARKS

ALSO FLOWN ON NIMBUS 2, 3. MODIFIED VERSION WILL FLY ON NIMBUS D

66. DIAGRAMS

NIMBUS 2

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
ADVANCED VIDICON CAMERA SYSTEM	AVCS	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
ARLAUSKAS, J.	GODDARD SPACE FLT CENTER	301-982-6621
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
PRESS, H.	GODDARD SPACE FLT CENTER	301-982-6142

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					POST FLIGHT

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B. B.	NASA HDQTRS	OSSA/SRN	202-962-0891

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
RCA ASTRO-ELECTRONICS	PRINCETON, N.J.	08/64	NA

26. INSTRUMENT TYPE	27. SECURITY
IMAGER, 1-INCH WIDE-ANGLE HIGH-RESOLUTION VIDICON	UNC

28. APPLICATION	29. SPACECRAFT
MET, ERSP	NIMBUS 2

30. PURPOSE

PRIMARY-TO OBSERVE THE ENTIRE DAYTIME CLOUD COVER OF THE EARTH ONCE A DAY FOR METEOROLOGICAL RESEARCH PURPOSES. ***SECONDARY-TO TEST THE SYSTEM IN SPACE PRIOR TO APPLICATION IN AN OPERATIONAL SPACECRAFT SYSTEM.

31. PRINCIPLES OF OPERATION

THE AVCS TEST FLOWN ON NIMBUS 1 AND 2 AND OPERATIONALLY ON ESSA 3 AND 5 ARE SIMILAR EXCEPT FOR THE LENS USED AND NIMBUS HAVING 3 CAMERAS TO ESSA'S 2. ON NIMBUS THE 3 VIDICON CAMERAS ARE DEPLOYED IN A FAN-LIKE ARRAY TO PRODUCE A 3-SEGMENT COMPOSITE PICTURE. EACH CAMERA COVERS A 37 DEG FOV WITH THE CENTER CAMERA POINTING STRAIGHT DOWN. THE OPTICAL AXIS OF THE OTHER 2 UNITS ARE ROTATED 35 DEG TO EITHER SIDE OF LOCAL VERTICAL. A 3-PICTURE SET IS TAKEN EVERY 91 SECS AND COVERS AN AREA OF APPROX 400,000 SQ MI WITH 96 PICTURES PER ORBIT ACQUIRED. THE PICKUP TUBES ARE 833 SCANLINE, 1-IN DIAM VIDICONS GIVING A LINEAR RESOLUTION OF ABOUT 0.5 NM AT THE OPTICAL CENTER AT 575 NM ALT. EACH OF THE 3 CAMERAS EMPLOY A 17 MM F/4 LENS WITH A SERVOCONTROLLED IRIS FOR EXPOSURE ADJUSTMENT. SHUTTER SPEED IS SET AT 40 MILLISEC EXPOSURE TIME. A POTENTIOMETER ATTACHED TO THE SOLAR ARRAY CONTROLS THE LENS OPENING FROM F/16 WHEN THE SPACECRAFT IS OVER THE EQUATOR TO F/4 WHEN THE S/C IS NEAR THE POLES. THE CAMERAS ARE PROGRAMMED TO OPERATE ONLY AT A SUN ANGLE OF HIGHER THAN 85 DEG. A TAPE RECORDER WITH 1200 FT OF TAPE WILL RECORD 2 COMPLETE ORBITS OF 192 PICTURES. THESE VIDEO SIGNALS ARE TRANSMITTED TO THE GROUND IN 4 MIN USING THE 1707.5 MHZ TRANSMITTER.

32. PHENOMENA OBSERVED

CLOUD COVER OVER THE EARTH'S SURFACE

33. MEASUREMENT RANGE

DYNAMIC RANGE OF 14 TO 11,400 FOOT-LAMBERTS

34. PRECISION AND ACCURACY

8-10 LEVELS OF GRAY, 833 LINE RESOLUTION

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.45 TO 0.65 MICRON	NA	

38. FIELD OF VIEW	39. GROUND SWATH
37.0 DEG	400 NM DIAM CIRCLE FROM 600 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.5 DEG	0.5 NM AT CENTER FROM 575 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED CIRCULAR	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

3 VIDICON CAMERAS, ASSOCIATED ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
63 LB		7 WATTS			12 MON

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
	SENSITIVE			MAGNETIC SHIELDING USED

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
GRAY-SCALE CALIBRATOR	DELAYED TELEMETRY	CONTINUOUS DAYTIME

62. TELEMETRY REQUIREMENTS

NIMBUS S-BAND TRANSMITTER USED TO TRANSMIT VIDEO SIGNAL TO GROUND STATION USING THE 1707.5 MHZ FREQUENCY.

63. ADVANTAGES AND LIMITATIONS

IMPROVEMENTS OVER NIMBUS 1 AVCS IN RELIABILITY, PERFORMANCE, AND LIFE CHARACTERISTICS

64. REFERENCES

1) SIGNIFICANT ACHIEVEMENTS IN SATELLITE MET, 1958-1964, NASA SP-96.***2) INSTRUMENTS AND SPACECRAFT OCT 57-MAR 65, NASA SP-3028.***3) NIMBUS 2 USER'S GUIDE. GSFC, JULY 66.***4) OSTROW, H. AND WEINSTEIN, O.: REVIEW OF A DECADE OF SPACE CAMERA SYSTEMS DEVELOPMENT FOR MET., GSFC, 1968.***5) DATA AVAILABLE FROM NATIONAL WEATHER RECORDS CTR (ESSA), ASHEVILLE, N.C.

65. HISTORICAL REMARKS

SIMILAR TO AVCS ON NIMBUS 1, ESSA 3, AND ESSA 5.

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
AUTOMATIC PICTURE-TRANSMISSION SYSTEM	APT	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
STAMPFL, DR. R.A.	GODDARD SPACE FLT CENTER	301-982-6163
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					POST FLIGHT

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B. B.	NASA HDQTRS	OSSA/SRN	202-962-0891

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
RCA ASTRO-ELECTRONICS	PRINCETON, N.J.	05/66	NA

26. INSTRUMENT TYPE	27. SECURITY
IMAGER, 1-INCH AUTOMATIC-PICTURE-TRANSMISSION VIDICON	UNC

28. APPLICATION	29. SPACECRAFT
MET	NIMBUS 2

30. PURPOSE

PRIMARY-TO PROVIDE REAL-TIME WIDE-ANGLE CLOUD COVER PICTURES FOR USE BY LOCAL USERS.***SECONDARY-CHECKOUT FOR SENSORS TO BE USED IN FUTURE OPERATIONAL TOS FLIGHTS.

31. PRINCIPLES OF OPERATION

THE APT SYSTEM WAS TEST FLOWN IN VARIOUS MODES OF SOPHISTICATION ON TIROS 8 AND NIMBUS 1 AND 2, PRIOR TO OPERATIONAL TOS FLIGHTS (ESSA 2,4,6) AND TIROS M. NIMBUS 2 USED A SINGLE 1-INCH CAMERA VIDICON ARRANGEMENT DESIGNED TO OPERATE FROM A SPIN STABILIZED SPACECRAFT. THIS CAMERA HAD AN IMPROVED LONG STORAGE TIME PHOTOCONDUCTOR. THE CAMERA UTILIZED A TEGEA-KINOPTIC, 108-DEGREE, WIDE ANGLE, F/1.8 OBJECTIVE LENS WITH A FOCAL LENGTH OF 6.0 MM. THE SYSTEM AUTOMATICALLY TAKES AND TRANSMITS A PICTURE EVERY 208 SECS WHILE THE SATELLITE IS IN DAYLIGHT. OPTICAL EXPOSURE TIME IS 40 MILLISECONDS, GIVING SMEAR OF LESS THAN 10 PERCENT OF ONE PICTURE ELEMENT. AN 8-SECOND TURN-ON AND SYNC SIGNAL PRECEDES THE 200 SEC TRANSMISSION. DURING THIS LATTER PERIOD, THE VIDICON IS SCANNED AT FOUR LINES PER SECOND, AND THE SIGNALS TRANSMITTED PRODUCING AN 800-LINE PICTURE WITH SCAN LINES PERPENDICULAR TO THE ORBIT TRACK. A 5-WATT TV TRANSMITTER BROADCASTS THE SIGNAL IN THE 136.95 MHZ SPACE TELEMETRY BAND. AN APT GROUND STATION WITH AN APPROPRIATE ANTENNA, RECEIVER, AND A RECORDER COMPATIBLE WITH SLOW SCAN TV TRANSMISSION CAN RECEIVE THESE PICTURES WHEN THE SPACECRAFT IS WITHIN ACQUISITION RANGE. THE SYSTEM IS COMPATIBLE WITH COMMERCIAL 240 RPM FACSIMILE EQUIPMENT.

32. PHENOMENA OBSERVED

CLOUD AND TERRAIN FEATURES OF 2 NM OR LARGER

33. MEASUREMENT RANGE

DYNAMIC PICTURE RANGE OF 25:1

34. PRECISION AND ACCURACY

10 LEVELS OF GREY; 30-DB S/N AT 0.7 FOOT-CANDLES/SEC

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.45 TO 0.65 MICRON	NA	

38. FIELD OF VIEW	39. GROUND SWATH
89.0 BY 89.0 DEG	1200 NM BY 1200 NM FROM 600 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.162 DEG	1.7 NM FROM 600 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
1.0 DEG	0.1 DEG/SEC	MED CIRCULAR	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

VIDICON, ELECTRONICS, TRANSMITTER, TAPE RECORDER

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
30 LB				40 WATTS	6 MON

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
SENSITIVE	SENSITIVE			MAGNETIC SHIELDING USED

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
FIDUCIAL MARKS INCLUDED	REALTIME TELEMETRY	CONTINUOUS DAYTIME

62. TELEMETRY REQUIREMENTS

PICTURE IS COMMUNICATED TO AN EARTH STATION IN THE SPACE RES. BAND OF 136-137 MHZ. THE VIDEO OUTPUT REQUIRES 4000 HZ MAXIMUM FREQUENCY CAPABILITY.

63. ADVANTAGES AND LIMITATIONS

IMPROVEMENTS OVER PRIOR APT RELIABILITY, PERFORMANCE, AND LIFE CHARACTERISTICS.

64. REFERENCES

1) SIG ACHIEV IN SAT MET 1958-1964, NASA SP-96.***2) STAMPFL, R. A. AND STROUD, W.G.: THE APT TV CAMERA SYSTEM FOR MET SATS, JOUR SMPTE, VOL 73, FEB 1964.***3) NIMBUS II USER'S GUIDE, GSFC, JULY 1966.***4) SIG ACHIEV IN SPACE APP 1965. NASA SP-137, 1966. ***5) SIG ACHIEV IN SPACE APP, 1966. NASA SP-156, 1967. ***6) BALAKRISHNAN: ADV IN COMM SYSTEMS, VOL 1, CHAP 5, STAMPFL

65. HISTORICAL REMARKS

SIMILAR TO APT ON NIMBUS 1;ESSA 2,4,6;TIROS 8;SCHED FOR TIROS M

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
HIGH-RESOLUTION INFRARED RADIOMETER	HRIR	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/16/69	0003

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
FOSHEE, L.L.	GODDARD SPACE FLT CENTER	
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					POST FLIGHT

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
HALEY, DR. R.	NASA HDQTRS	OSSA/SAN	202-962-0891

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
ITT INDUSTRIAL LABS	FORT WAYNE, INDIANA	05/66	

26. INSTRUMENT TYPE	27. SECURITY
RADIOMETER, SINGLE-CHANNEL SCANNING INFRARED	UNC

28. APPLICATION	29. SPACECRAFT
MET, ERSP	NIMBUS 2

30. PURPOSE

PRIMARY- TO MAP THE EARTH'S CLOUD COVER AT NIGHT TO COMPLEMENT THE TV COVERAGE DURING THE DAYTIME PORTION OF THE ORBIT.*** SECONDARY-TO MEASURE THE TEMPERATURES OF CLOUD TOPS AND TERRAIN FEATURES.

31. PRINCIPLES OF OPERATION

THE SINGLE CHANNEL SCANNING HRIR WAS FLOWN IN NIMBUS 1 AND 2. MODIFIED VERSIONS ARE SCHEDULED FOR FLIGHT ON NIMBUS B AND D. THE NIMBUS 2 HRIR CONTAINED A LEAD SELENIDE (PBSE) PHOTOCONDUCTIVE CELL WHICH IS RADIATION COOLED TO -75 DEGREES C AND OPERATES IN THE 3.4 TO 4.2 MICRON REGION. COOLING IS ACCOMPLISHED BY MEANS OF A BLACK COOLING PATCH AT THE BOTTOM OF A HIGHLY REFLECTIVE GOLD-COATED HORN. THE RADIOMETER HAS AN INSTANTANEOUS FOV OF 1/2 DEG, WHICH AT AN ALTITUDE OF 600 NM GIVES A GROUND RESOLUTION OF 5 NM. THE SCAN MIRROR IS INCLINED 45 DEGREES TO THE AXIS OF ROTATION AND CONTINUOUSLY ROTATES THE FIELD OF VIEW OF THE DETECTOR THROUGH 360 DEG IN A PLANE NORMAL TO THE SPACECRAFT VELOCITY. THE VIEW OF THE HOUSING AND SPACE DURING A ROTATION PROVIDE ZERO AND WARM BODY CALIBRATION POINTS. THE RADIATION REFLECTED FROM THE SCAN MIRROR IS CHOPPED AT 1.5 KHZ AT THE FOCUS OF A 4 INCH F/1 MODIFIED CASSEGRAINIAN TELESCOPE. IT IS THEN REFOCUSED AT THE DETECTOR BY RELAY MIRRORS WITH THE 3.4-4.2 MICRON WAVELENGTH FILTER BETWEEN THEM. THE SCAN RATE IS 44.7 RPM. THE OUTPUT SIGNAL HAS AN INFORMATION BANDWIDTH OF 280 HZ. THE INFORMATION IS STORED ON TAPE FOR PLAYBACK ON COMMAND OR IS TRANSMITTED DIRECTLY TO APT STATIONS.

32. PHENOMENA OBSERVED

EMITTED SURFACE RADIATION FROM 3.4 TO 4.2 MICRONS

33. MEASUREMENT RANGE

RADIANT TEMPERATURE BETWEEN 210 AND 330 DEGREES KELVIN

34. PRECISION AND ACCURACY

NOISE EQUIVALENT TEMP DIFF OF 1 DEG K FOR A 250 DEG K BACKGROUND

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
3.4 TO 4.2 MICRONS		

38. FIELD OF VIEW	39. GROUND SWATH
90. BY 0.5 DEG	1300 NM BY 5 NM FROM 600 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.5 DEG	5 NM FROM 600 ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED CIRCULAR	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

RADIOMETER, RECORDER, ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
12 LB		4 WATTS		12 WATTS	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
SENSITIVE			SENSITIVE	RF SHIELD;RADIATIVE COOL

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
2 MEAS EACH 360 DEG SCAN	DELAYED AND REALTIME	NIGHTSIDE OF ORBIT

62. TELEMETRY REQUIREMENTS

THE AC SIGNAL IS RECTIFIED, RESULTING IN A DC OUTPUT VARYING FROM 0 TO -6 VOLTS AND HAVING A VIDEO BANDWIDTH OF 280 HZ.

63. ADVANTAGES AND LIMITATIONS

IMPROVED SHIELDING REDUCED RF INTERFERENCE ON DATA WHEN APT WAS OPERATING; USEFUL DATA ONLY DURING NIGHT.

64. REFERENCES

1) NIMBUS 2 USER'S GUIDE. GSFC, JULY 1966.***2) SIG ACHIEV IN SPACE APP 1966. NASA SP-156, 1967.***3) GOLBERG, I.L.: METEOROLOGY INSTRUMENTS FOR SATELLITES. PRESENTED AT 13TH ANNUAL TECH SYMP OF SOC PHOTO-OPTICAL ENGR., AUG 23, 1968.***4) OBSERVATIONS FROM NIMBUS 1 MET SAT. NASA SP-89, 1965.***5) HRIR DATA AVAILABLE FROM: NIMBUS DATA, CODE 650, NASA SPACE SCIENCE CTR, GSFC.

65. HISTORICAL REMARKS

ALSO FLOWN ON NIMBUS 1, 3. MODIFIED VERSION WILL FLY ON NIMBUS D

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
MEDIUM-RESOLUTION INFRARED RADIOMETER	MRIR	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
MCCULLOCH, A.	GODDARD SPACE FLT CENTER	301-982-4347
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					POST FLIGHT

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B. B.	NASA HDQTRS	OSSA/SRN	202-962-0891

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
SANTA BARBARA RES CTR	GOLETA, CALIFORNIA	05/66	NA

26. INSTRUMENT TYPE	27. SECURITY
RADIOMETER, 5-CHANNEL MEDIUM-RESOLUTION IR/VISIBLE SCANNING	UNC

28. APPLICATION	29. SPACECRAFT
MET, ERSP	NIMBUS 2

30. PURPOSE

PRIMARY-TO MEASURE ELECTROMAGNETIC RADIATION EMITTED AND REFLECTED FROM THE EARTH AND ITS ATMOSPHERE IN 5 SELECTED WAVELENGTH INTERVALS. PARAMETERS TO BE STUDIED ARE: ATMOSPHERIC WATER VAPOR ABSORPTION BAND; SURFACE OR NEAR-SURFACE TEMPERATURE AND CLOUD COVER DATA; RADIATION FROM STRATOSPHERE(CO_2) BAND ; HEAT BUDGET OF THE EARTH AND INTENSITY OF REFLECTED SOLAR ENERGY.

31. PRINCIPLES OF OPERATION

THE 5 CHANNEL NIMBUS MRIR, USING FILTERS AND BOLOMETER DETECTORS, WAS SIMILAR IN PURPOSE TO THE EARLIER TIROS MRR BUT WAS A NEW INSTRUMENT DESIGN. THE SPECTRAL INTERVALS WERE: 6.4-6.9, 10-11, 14-16, 5.0-30.0, AND 0.2-4.0 MICRONS. THE RADIANT ENERGY FROM THE EARTH IS COLLECTED BY A FLAT SCANNING MIRROR INCLINED AT 45 DEG TO THE OPTICAL AXIS. THE MIRROR ROTATES AT 8 RPM AND SCANS IN A PLANE PERPENDICULAR TO THE DIRECTION OF MOTION OF THE SATELLITE. EACH OF THE 5 CHANNELS CONTAINS A 1.7 IN. DIAMETER FOLDED TELESCOPE AND A THERMISTOR BOLOMETER WITH A 2.8 DEG FOV. CALIBRATION OF THE IR CHANNELS OCCUR AT 2 POINTS DURING EACH SCAN, COLD SPACE AND THE RADIOMETER HOUSING. THE INCIDENT FLUX FOCUSED ON THE BOLOMETER DETECTOR IS MODULATED AT 60 HZ BY A MECHANICAL CHOPPER TO PRODUCE AN A.C. SIGNAL FROM THE DETECTOR, (REFERENCE TEMP OF THE RADIOMETER). THE ABSOLUTE TEMP OF THE TARGET IS DETERMINED BY INTRODUCING AN ELECTRONIC VOLTAGE IN SUCH A PROPORTION THAT A TARGET OF A GIVEN TEMP WILL ALWAYS PRODUCE THE SAME ABSOLUTE VOLTAGE OUTPUT. THE ELECTRICAL SIGNAL FROM THE DETECTOR IS THEN AMPLIFIED AND SYNCHROUNOUSLY DEMODULATED TO YIELD AN ANALOG OUTPUT OF 0 TO -6.4 VOLTS TO COVER THE DESIRED RANGE OF TARGET TEMPERATURE FOR EACH CHANNEL.

32. PHENOMENA OBSERVED

RADIATION FROM THE EARTH AND ITS ATMOSPHERE

33. MEASUREMENT RANGE

34. PRECISION AND ACCURACY

A S/N RATIO OF BETTER THAN 30 DB; ABSOLUTE ACCURACY OF +-3 DEG C

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.2 TO 30.0 MICRONS	SEE ITEM 31	

38. FIELD OF VIEW	39. GROUND SWATH
2.8 DEG	29 NM DIAM CIRCLE FROM 600 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
2.8 DEG	29 NM FROM 600 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED CIRCULAR	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

RADIOMETER, ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
14 LB		7 WATTS			

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
			SENSITIVE	

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
COLD SPACE AND HOUSING	DELAYED TELEMETRY	CONTINUOUS

62. TELEMETRY REQUIREMENTS

ANALOG SIGNALS ARE SAMPLED 33-1/3 TIMES PER SEC AND CONVERTED TO 7-BIT DIGITAL DATA. EACH DATA WORD BIT IS THEN RECORDED ON TAPE FOR PLAYBACK.

63. ADVANTAGES AND LIMITATIONS

IMPROVED SPECTRAL RESPONSE AND AN IN-FLIGHT CALIBRATION OF THE SIGNAL LEVEL HAS INCREASED ACCURACY OF DATA OVER TIROS MRR.

64. REFERENCES

1) NIMBUS 2 USER'S GUIDE. GSFC, JUL.66.***2) DATA CATALOG OF SATELLITE AND ROCKET EXPERIMENTS. NASA/GSFC, NATIONAL SPACE SCI DATA CTR, REPORT NO. NSSDC 68-01, JAN 68.***3) SIG ACHIEV IN SPACE APP. NASA SP-156, 1967.***4) GOLDBERG, I.L.: MET IR INSTRUMENTS FOR SATELLITES., NASA/GSFC, AUG.68.***5) DATA AVAILABLE FROM NATIONAL SPACE SCIENCE DATA CENTER, NASA/GSFC.

65. HISTORICAL REMARKS

SIMILAR IN PURPOSE TO EARLIER TIROS MRR, BUT NEW DESIGN.

66. DIAGRAMS

NIMBUS 3

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
HIGH-RESOLUTION INFRARED RADIOMETER (TITLE CONT.)	HRIR	

4. RESUME DATE	5. VERSION
11/10/69	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
CHERRIX, G.T.	GODDARD SPACE FLT CENTER	301-982-5754
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
ALLISON, L.J.	GODDARD SPACE FLT CENTER	301-982-5948

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					OPERATIONAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B. B.	NASA HDQTRS	OSSA/SRN	202-962-0891

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
ITT INDUSTRIAL LABS	FORT WAYNE, INDIANA	04/69	NA

26. INSTRUMENT TYPE	27. SECURITY
RADIOMETER, DUAL-CHANNEL INFRARED SCANNING	UNC

28. APPLICATION	29. SPACECRAFT
MET, ERSP	NIMBUS 3

30. PURPOSE

PRIMARY-TO PROVIDE BOTH DAYTIME CLOUD MAPPING AND NIGHTTIME RADIATION MEASUREMENTS ON A FULL TIME BASIS.***SECONDARY- TO PROVIDE THIS INFORMATION TO APT STATIONS IN REALTIME ANYWHERE IN THE WORLD AS THE NIMBUS 3 PASSES OVERHEAD.

31. PRINCIPLES OF OPERATION

A SINGLE-CHANNEL SCANNING HRIR WAS FLOWN ON NIMBUS 1 AND 2. A MODIFIED VERSION IS SCHEDULED FOR NIMBUS 3. THE NIMBUS 3 HRIR WILL PROVIDE DATA IN 2 SPECTRAL REGIONS. NIGHTTIME DATA (3.4 TO 4.2 MICRONS) WILL PROVIDE CLOUD TOP OR SURFACE TEMPERATURES AS IN PREVIOUS HRIR'S. THROUGH THE USE OF A DUAL BAND-PASS FILTER, DAYTIME DATA (0.7 TO 1.3 MICRONS) WILL PRIMARILY PROVIDE MAPS OF CLOUD COVER BY MEASURING RELATIVE REFLECTED SOLAR RADIATION. THE HRIR SENSES RADIATION WITH A LEAD SELENIDE PHOTO-CONDUCTIVE CELL WHICH IS RADIATIVELY COOLED TO -75 DEG C. THE SCAN MIRROR IS INCLINED 45 DEG TO THE AXIS OF ROTATION AND CONTINUOUSLY ROTATES THE FOV OF THE DETECTOR THROUGH 360 DEG AT A RATE OF 48 RPM, IN A PLANE NORMAL TO THE SPACECRAFT VELOCITY. THE VIEW OF THE HOUSING AND SPACE DURING A ROTATION PROVIDE ZERO AND WARM BODY CALIBRATION POINTS. THE RADIATION REFLECTED FROM THE SCAN MIRROR IS CHOPPED AT 1.5 KHZ AT THE FOCUS OF A 4 INCH F/1 MODIFIED CASSEGRAINIAN TELESCOPE. IT IS THEN REFOCUSED AT THE DETECTOR BY RELAY MIRRORS WITH THE FILTER BETWEEN THEM. THE OUTPUT SIGNAL HAS AN INFORMATION BANDWIDTH OF 350 HZ. THIS INFORMATION IS STORED ON TAPE FOR PLAYBACK ON COMMAND OR CAN BE TRANSMITTED DIRECTLY TO APT GROUND STATIONS.

32. PHENOMENA OBSERVED

EMITTED CLOUD-TOP AND SURFACE RADIATION DURING NIGHT AND DAY

33. MEASUREMENT RANGE

RADIANT TEMPERATURE BETWEEN 210 AND 330 DEG K.

34. PRECISION AND ACCURACY

CLOUD-TOP ALTITUDE TO 1000 FT; SURFACE TEMP TO APPROX 1 C DEG

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.7 TO 4.2 MICRONS		

38. FIELD OF VIEW	39. GROUND SWATH
90. BY 0.5 DEG	1300 NM BY 5 NM FROM 600 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.5 DEG	5 NM AT CENTER FROM 600 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
1.0 DEG		MED CIRCULAR	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

RADIOMETER, ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
18 LB		9 WATTS			

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
			SENSITIVE	RADIATIVE COOLING

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
2 MEAS EACH 360 DEG SCAN	DELAYED AND REALTIME	CONTINUOUS

62. TELEMETRY REQUIREMENTS

VIDEO INFORMATION BANDWIDTH IS 350 HZ.

63. ADVANTAGES AND LIMITATIONS

THIS HRIR CAN PROVIDE USEFUL DAYTIME PICTURES WHERE PREVIOUS ONES COULD NOT; MOVING PARTS

64. REFERENCES

1) GOLDBERG, I.L.: METEOROLOGY INSTRUMENTS FOR SATELLITES. PRESENTED AT 13TH ANNUAL TECH SYMP OF SOC PHOTO-OPTICAL ENGRS, AUG 23, 1968.***2) NIMBUS B PRESS KIT, NO. 68-84K, NASA MAY 10, 1968 ***3) NIMBUS 2 USER'S GUIDE. GSFC, JULY 1966.***4) SABATINI, R.R.: NIMBUS B DATA UTILIZATION PLAN. ALLIED RES ASSOC, TECH REPT NO. 4, MARCH, 1968.

65. HISTORICAL REMARKS

SINGLE-CHANNEL HRIR WAS FLOWN ON NIMBUS 1 AND 2.

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
IMAGE-DISSECTOR CAMERA SYSTEM	IDCS	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
BRANCHFLOWER, G.	GODDARD SPACE FLT CENTER	301-982-5539
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
	NAS5-9619				OPERATIONAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B. B.	NASA HDQTRS	OSSA/SRN	202-962-0891

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
ITT INDUSTRIAL LABS	FORT WAYNE, INDIANA	04/69	NA

26. INSTRUMENT TYPE	27. SECURITY
IMAGER, 1-INCH PHOTOCATHODE ELECTRICALLY-SCANNING VISIBLE	UNC

28. APPLICATION	29. SPACECRAFT
MET	NIMBUS 3

30. PURPOSE

PRIMARY-TO ACQUIRE HIGH-RESOLUTION PHOTOGRAPHS OF THE EARTH'S DAYTIME CLOUD COVER.

31. PRINCIPLES OF OPERATION

THE IMAGE DISECTOR CAMERA PERFORMS THE FUNCTIONS THAT PREVIOUSLY REQUIRED BOTH AN AVCS AND AN APT. IT HAS ALSO FLOWN ON ATS 3, BUT WITH DIFFERENT OPTICS, AND IS SCHEDULED FOR NIMBUS D. A SCENE IS OPTICALLY FOCUSED ON THE PHOTOCATHODE AND PHOTOELECTRONS ARE EMITTED FROM THE SURFACE IN PROPORTION TO THE INCIDENT ILLUMINATION. THE PHOTOELECTRONS ARE ACCELERATED TOWARD AND FOCUSED ON A PLANE WHICH CONTAINS A PINHOLE APERTURE AT ITS CENTER. THE ELECTRON IMAGE IS DEFLECTED PAST THE APERTURE BY MEANS OF MAGNETIC DEFLECTION. THE APERTURE SAMPLES THE ELECTRON IMAGE AND A SECONDARY-EMISSION ELECTRON-MULTIPLIER SECTION AMPLIFIES THE SIGNAL BY ABOUT 10 MILLION. THE CAMERA IS USED IN THE LINE SCAN MODE WITH THE SPACECRAFT MOTION ALONG THE ORBITAL TRACK PROVIDING THE OTHER SCAN COMPONENT. NO SHUTTER IS REQUIRED AS THE SENSOR IS NON-STORAGE TYPE, AND EXPOSURE TO THE SCENE IS CONTINUOUS. THE VERY NARROW BANDWIDTH (1800 HZ) RESULTS IN GENERATION OF A VIDEO SIGNAL WITH THE HIGH NOMINAL S/N OF 40 DB. THE CAMERA-LINE FREQUENCY IS 4 HZ WITH THE FRAME PERIOD BEING 200 SEC. THE LENS APERTURE IS FIXED AT F/3. THE GROUND RESOLUTION IS 1.7 NM AT THE SUBSATELLITE POINT. REALTIME PICTURES CAN BE TRANSMITTED TO APT RECEIVING STATIONS.

32. PHENOMENA OBSERVED

VISIBLE LIGHT REFLECTED FROM EARTH AND ITS CLOUD COVER

33. MEASUREMENT RANGE

100 TO 10,000 FOOT-LAMBERTS

34. PRECISION AND ACCURACY

800 TV LINE RESOLUTION; S/N = 40 DB AT 10,000 FOOT-LAMBERTS

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.4 TO 0.7 MICRON		

38. FIELD OF VIEW	39. GROUND SWATH
92.0 BY 92.0 DEG	1300 NM BY 1300 NM FROM 600 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.11 DEG	1.7 NM AT CENTER FROM 600 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED CIRCULAR	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

SPACECRAFT ATTITUDE ERRORS MUST BE HELD TO VERY SMALL VALUES

47. COMPONENTS

IMAGE DISECTOR, SCANNING APERTURE, 12 STAGE ELECTRON MULTIPLIER

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
14 LB	0.2 CU FT	12 WATTS	1 WATT		

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
	SOURC/SEN			

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
	DELAYED AND REALTIME	14 PICTURES/ORBIT

62. TELEMETRY REQUIREMENTS

VIDEO BANDWIDTH IS 1800 HZ.

63. ADVANTAGES AND LIMITATIONS

REPLACES AVCS AND APT CAMERAS FLOWN ON NIMBUS 1 AND 2; REDUCES NUMBER OF PICTURES TO ONE-SIXTH PREVIOUS AMOUNT.

64. REFERENCES

1) NORMYLE, W.J.: NIMBUS B TO TEST NEW WEATHER SENSORS, IN AVIATION WEEK AND SPACE TECHNOLOGY, MAY 6, 1968, PP. 71-69.***2) PRESS KIT NIMBUS B, NASA RELEASE NO. 68-48K, MAY 1968.***3) OSTROW, H. AND O. WEINSTEIN,: A REVIEW OF A DECADE OF SPACE CAMERA SYSTEMS DEVELOPMENT FOR METEOROLOGY, PRESENTED AT SOCIETY OF PHOTO-OPTICAL INSTRUMENTATION ENGINEERS, WASH. D.C., AUG 1968.

65. HISTORICAL REMARKS

REPLACES AVCS PLUS APT. FLOWN ON ATS 3. SCHEDULED FOR NIMBUS D.

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
INFRARED INTERFEROMETER/SPECTROMETER	IRIS	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0006

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
HANEL, R.A.	GODDARD SPACE FLT CENTER	301-982-4528
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
CHANEY, L.	UNIVERSITY OF MICHIGAN	313-764-7210

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					OPERATIONAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B. B.	NASA HDQTRS	OSSA/SRN	202-962-0891

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
TEXAS INSTRUMENTS	DALLAS, TEXAS	04/69	NA

26. INSTRUMENT TYPE	27. SECURITY
SPECTROMETER, INFRARED INTERFEROMETER	UNC

28. APPLICATION	29. SPACECRAFT
MET	NIMBUS 3

30. PURPOSE

PRIMARY- TO DETERMINE THE VERTICAL PROFILE OF TEMPERATURE, THE VERTICAL DISTRUBUTIONS OF OZONE AND WATER VAPOR, AND THE TEMPERATURE OF THE EARTH'S SURFACE OR CLOUD TOPS.***SECONDARY-TO IDENTIFY SOME OF THE GASES PRESENT IN THE ATMOSPHERE.

31. PRINCIPLES OF OPERATION

THIS IS A TWYMAN-GREEN MODIFICATION OF A MICHELSON INTERFEROMETER SPECTROMETER OPERATING IN THE 5.0 TO 20 MICRON WAVELENGTH RETION WITH A FOV OF 8 DEGREES. RADIATION FROM A CYLINDER OF ATMOSPHERE, WHOSE BASE ON THE EARTH'S SURFACE IS A CIRCLE 80 NM IN DIAMETER, IS REFLECTED INTO THE INSTRUMENT FROM A PLANE MIRROR WHICH ROTATES TO PROVIDE IMC. THE RADIATION IS SPLIT INTO TWO BEAMS, ONE OF WHICH IS REFLECTED FROM A MOVING MIRROR, RECOMBINED AND FOCUSED ONTO A BOLOMETER DETECTOR. INTERFERENCE EFFECTS RESULT FROM THE PATH LENGTH DIFFERENCES IN THE 2 BEAMS AS THE MIRROR MOVES. IT TRAVELS ABOUT 2 MM IN 11 SEC TO GIVE AN INTERFEROGRAM WHICH IS RECORDED ON TAPE. OBSERVATIONS ARE BEGUN 16 SEC APART IN WHICH TIME THE S/C TRAVELS ABOUT 65 NM. THUS THERE IS NO OVERLAP IN SUCCESSIVE OBSERVATIONS. AFTER RECORDING 14 INTERFEROGRAMS, 2 CALIBRATION OBSERVATIONS ARE MADE, ONE FOR A REFERENCE BLACKBODY AT 300 K AND ONE FOR OUTER SPACE. A FOURIER TRANSFORMATION, PERFORMED BY DIGITAL COMPUTER, MUST BE MADE ON EACH TELEMETERED INTERFEROGRAM TO PRODUCE A SPECTRUM. THEN, TO RELATE THIS TO ATMOSPHERIC CONDITIONS, APPROPRIATE SPECTRAL ABSORPTION REGIONS MUST BE CHOSEN AND EMPLOYED IN AN INVERSION OF THE RADIATIVE TRANSFER EQUATIONS

32. PHENOMENA OBSERVED

EMISSION FROM THE EARTH IN THE SPECTRAL REGION 5-20 MICRONS

33. MEASUREMENT RANGE

NEAR ZERO TO 300 DEGREES KELVIN

34. PRECISION AND ACCURACY

FOR TEMP, 2 DEG C; FOR WATER VAPOR AND SCALE HEIGHT, 10 PER CENT

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
5.0 TO 20.0 MICRONS	0.1 MICRON	1.0 MILLSEC

38. FIELD OF VIEW	39. GROUND SWATH
8.0 DEG	80 NM DIAM CIRCLE FROM 600 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
8.0 DEG	80 NM FROM 600 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED CIRCULAR	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

IMAGE MOTION COMPENSATION REQUIRED TO ELIMINATE SMEAR

47. COMPONENTS

MICHELSON INTERFEROMETER SPECTROMETER, ROTATING MIRROR, BOLOMETER

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
28 LB		12 WATTS		24 WATTS	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
			SENSITIVE	THERMAL SHIELDING REQ'D

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
SEE ITEM 31	DELAYED TELEMETRY	EVERY 16 SECONDS

62. TELEMETRY REQUIREMENTS

3.75 KBITS FOR 11 OUT OF 16 SECONDS; 18 MEGABITS PER ORBIT

63. ADVANTAGES AND LIMITATIONS

OVERLY WIDE (2500 KM) LONGITUDINAL SEPARATION AT EQUATOR, LIMITED TO ABOVE CLOUDS.

64. REFERENCES

1) MINZNER, R.A. ED: INTERIM REPORT ON SATELLITE METEOROLOGICAL INSTRUMENTS, NASA/ERC PM-6713, JUNE 1967.***2) HANEL, R.A. AND L. CHANEY: THE INFRARED INTERFEROMETER SPECTROMETER EXPERIMENT (IRIS): VOL,2-METEOROLOGICAL MISSION, NASA/GSFC DOCUMENT X-650-65-75.***3)HANEL, R. AND CHANEY,L.:THE MERITS AND SHORTCOMINGS OF AN IRIS TO OBTAIN MET DATA. GSFC RPT X-620-66-476, OCT 1966.

65. HISTORICAL REMARKS

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
INTERROGATION, RECORDING, AND LOCATION SYSTEM	IRLS	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
COTE, C.E.	GODDARD SPACE FLT CENTER	301-982-4101
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					OPERATIONAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B. B.	NASA HDQTRS	OSSA/SRN	202-962-0891

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
RADIATION, INC	MELBOURNE, FLORIDA	04/69	NA

26. INSTRUMENT TYPE	27. SECURITY
TRANSPONDER, UHF	UNC

28. APPLICATION	29. SPACECRAFT
MET, OCEAN, COMM, NAV, BIOL	NIMBUS 3

30. PURPOSE

PRIMARY- TO DEMONSTRATE THAT A SATELLITE CAN DETERMINE THE POSITION OF PLATFORMS CONTAINING SENSORS, RECORD THEIR DATA, AND THEN RADIO THE RESULTS TO A GROUND STATION FOR DISSEMINATION.*** SECONDARY- TO PROVIDE METEOROLOGICAL AND OTHER DATA AS SENSED BY REMOTE SENSORS.

31. PRINCIPLES OF OPERATION

THIS INSTRUMENT IS SIMILAR TO THAT FLOWN ON NIMBUS D. IT CONSISTS OF A TRANSMITTER (401.5 MHZ) WITH A VACUUM TUBE FINAL STAGE, RECEIVER (466 MHZ), DECODING AND CODING CIRCUITS, RANGE DETECTOR, AND MEMORY (20 KBIT). THE DATA MODULES, EACH WITH A UNIQUE ADDRESS, OF WHICH THE BALLOON INTERROGATION PACKAGE (BIP) IS AN EXAMPLE, CONTAIN A RECEIVER (401.5 MHZ), DECODING AND CODING CIRCUITS, DATA SENSORS AND A TRANSMITTER (466 MHZ). AS THE S/C PASSES WITHIN RANGE OF A COMMAND AND DATA ACQUISITION STATION (CDA) UP TO 20 COMMANDS CAN BE SENT AND STORED IN THE IRLS MEMORY. A COMMAND CONSISTS OF A TIME FOR AN INTERROGATION AND THE ADDRESS OF THE BIP (OR OTHER MODULE) TO BE CONTACTED. WHEN THE STORED COMMAND TIME AND THE S/C CLOCK TIME COINCIDE, THE S/C IRLS TRANSMITS THE ASSOCIATED BIP ADDRESS. THE BIP RESPONDS AND TRANSMITS ITS SENSOR READINGS. THESE AND THE ROUND TRIP SIGNAL DELAY TIME BETWEEN THE BIP AND THE S/C ARE STORED IN THE IRLS MEMORY. THIS PROCEDURE IS REPEATED FOR EACH STORED COMMAND UNTIL THE CDA INITIATES TRANSMISSION OF THE MEMORY CONTENTS AND THE STORAGE OF NEW COMMANDS IN THE MEMORY. KNOWING THE S/C POSITIONS AND TWO RANGES TAKEN ABOUT 150 SEC APART, THE POSITION OF A MODULE CAN BE FOUND TO WITHIN 2 KM.

32. PHENOMENA OBSERVED

TRANSMISSIONS OF DATA FROM REPORTING PLATFORMS

33. MEASUREMENT RANGE

34. PRECISION AND ACCURACY

PLATFORM LOCATION TO +-0.6 NM; DELAY TIME TO 0.625 MICROSECOND

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
466. AND 401.5 MHZ		

38. FIELD OF VIEW	39. GROUND SWATH

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED CIRCULAR	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

REACTS ONLY TO PREVIOUS GROUND COMMAND FOR SENSOR INTERROGATION

47. COMPONENTS

RECEIVER, TRANSMITTER, ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
26 LB	0.4 CU FT	18 WATTS		107 WATTS	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
SOURC/SEN			SENSITIVE	

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
	DELAYED TELEMETRY	ON COMMAND

62. TELEMETRY REQUIREMENTS

20 CHANNELS: 5 DIGITAL AND 15 ANALOG, SAMPLED BETWEEN 1 AND 16 SECONDS; 12.5 KBITS PER SECOND.

63. ADVANTAGES AND LIMITATIONS

LIMITED AT PRESENT TO 12 PLATFORMS

64. REFERENCES

1) NORMYLE, W.J.: NIMBUS B TO TEST NEW WEATHER SENSORS. AVAIATION WEEK AND SPACE TECHNOLOGY, MAY 6, 1968, PP. 71-79.***
2) PRESS KIT NIMBUS B, NASA RELEASE NO: 68-48K, MAY 1968.***3) NIMBUS B COMMAND AND TELEMETRY DIRECTORY, VOL.2; EXPERIMENT SUBSYSTEMS, GENERAL ELECTRIC CO., PHILADELPHIA, PA., 1967.

65. HISTORICAL REMARKS

SIMILAR TO NIMBUS D IRLS

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
MEDIUM-RESOLUTION INFRARED RADIOMETER	MRIR	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
MCCULLOCH, A.W.	GODDARD SPACE FLT CENTER	301-982-4347
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					OPERATIONAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B. B.	NASA HDQTRS	OSSA/SRN	202-962-0891

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
SANTA BARBARA RES CTR	GOLETA, CALIFORNIA	04/69	NA

26. INSTRUMENT TYPE	27. SECURITY
RADIOMETER, 5-CHANNEL MEDIUM-RESOLUTION SCANNING IR/VISIBLE	UNC

28. APPLICATION	29. SPACECRAFT
MET	NIMBUS 3

30. PURPOSE

PRIMARY-TO MEASURE SELECTED ELECTROMAGNETIC RADIATION EMITTED OR REFLECTED FROM THE EARTH AND ITS ATMOSPHERE TO OBTAIN DATA ON THE ALBEDO OF THE EARTH-ATMOSPHERE SYSTEM, WATER VAPOR DISTRIBUTION, SURFACE OR CLOUD TEMPERATURES AND SEASONAL CHANGES OF STRATOSPHERIC TEMPERATURES.***SECONDARY- TO PROVIDE ABSOLUTE RADIOMETRIC DATA TO AID IN EVALUATING DATA OF OTHER EXPERIMENTS.

31. PRINCIPLES OF OPERATION

THE 5 CHANNEL NIMBUS MRIR IS SIMILAR IN PURPOSE TO THE EARLIER TIROS MRR, BUT USES AN ENTIRELY NEW INSTRUMENT DESIGN. RADIATION ENTERS THE RADIOMETER BY REFLECTION FROM A FLAT SCANNING MIRROR INCLINED AT 45 DEG TO THE OPTICAL AXIS. A MECHANICAL CHOPPER MODULATES THE RADIATION AT 60 HZ. THE SPECTRAL REGIONS ARE SELECTED BY FILTERS. FOR THIS MRIR THE REGIONS (IN MICRONS) ARE 6.4-6.9 FOR WATER VAPOR DISTRIBUTION IN THE TROPOSPHERE, 10-11 FOR SURFACE OR CLOUD TEMPERATURES, 14.5-15.5 FOR STRATOSPHERIC TEMPERATURES, 20-23 FOR ANOTHER WATER VAPOR MEASUREMENT, AND 0.2-4.0 FOR ALBEDO MEASUREMENTS. EACH CHANNEL HAS A SEPARATE OPTICAL SYSTEM CONTAINING A FOLDED TELESCOPE WITH A 1.7 IN.DIAMETER OBJECTIVE AND A 2.8 DEG FOV. THE RADIATION IS FOCUSED ONTO A THERMISTOR BOLOMETER DETECTOR. THE SCANNING MIRROR ROTATES AT 8 RPM SCANNING IN A PLANE NORMAL TO THE S/C VELOCITY. DURING EACH REVOLUTION THE MIRROR VIEWS SPACE, THE EARTH FROM HORIZON TO HORIZON, SPACE AGAIN, AND THE RADIOMETER HOUSING. THE TEMPERATURES RECORDED FOR SPACE AND THE HOUSING ARE USED FOR CALIBRATION. THE OUTPUT FOR EACH DETECTOR IS A ZERO TO 6.4 VOLT ANALOG SIGNAL. THIS IS CONVERTED TO AN 8-BIT DIGITAL SIGNAL AND STORED ON TAPE FOR TRANSMISSION OVER S-BAND UPON COMMAND.

32. PHENOMENA OBSERVED

INFRARED RADIATION FROM THE EARTH AND ATMOSPHERE

33. MEASUREMENT RANGE

185-300 DEG K FOR 10 MCRN CHAN; 185-270 DEG K FOR 6,15 MCRN CHANS

34. PRECISION AND ACCURACY

S/N OF BETTER THAN 30 DB; ABSOLUTE ACCURACY OF +-7 DEG C

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.2 TO 23.0 MICRON		2.0 MILLSEC

38. FIELD OF VIEW	39. GROUND SWATH
360.0 BY 2.8 DEG	LIMB-TO-LIMB (3800 NM) FROM 600 NM ALT

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
2.8 DEG	25 NM FROM 600 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED CIRCULAR	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

RADIOMETER, ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
20 LB		8 WATTS	2 WATTS		

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
			SENSITIVE	

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
SPACE AND MRIR HOUSING	DELAYED TELEMETRY	CONTINUOUS

62. TELEMETRY REQUIREMENTS

ANALOG SIGNALS ARE SAMPLED 33-1/3 TIMES PER SEC AND CONVERTED TO 8-BIT DIGITAL DATA. EACH DATA WORD BIT IS THEN RECORDED ON TAPE FOR PLAYBACK.

63. ADVANTAGES AND LIMITATIONS

IMPROVED SPECTRAL RESPONSE AND IN-FLIGHT CALIBRATION HAS INCREASED ACCURACY OF DATA OVER TIROS MRIR; MOVING PARTS.

64. REFERENCES

1) GOLDBERG, I.L.: METEOROLOGY INSTRUMENTS FOR SATELLITES. PRESENTED AT 13TH ANNUAL TECH SYMP OF SOC PHOTO-OPTICAL ENGRS, AUG 23, 1968.***2) NIMBUS B PRESS KIT, NO:68-84K, NASA, MAY 10, 1968. ***3) NIMBUS 2 USER'S GUIDE. GSFC, JULY 1966.***4) SABATINI, R.R. NIMBUS B DATA UTILIZATION PLAN. ALLIED RES. ASSOC, TECH REPT NO. 4, MARCH 1968.

65. HISTORICAL REMARKS

SIMILAR IN PURPOSE TO EARLIER TIROS MRR

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
MONITOR OF ULTRAVIOLET SOLAR ENERGY	MUSE	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
HEATH, DR. D.F.	GODDARD SPACE FLT CENTER	301-982-6421
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					OPERATIONAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, R. R.	NASA HDQTRS	OSSA/SRN	202-962-0891

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
ADCOLE CORPORATION	WALTHAM, MASS	04/69	NA

26. INSTRUMENT TYPE	27. SENSITIVITY
SPECTROMETER, 5-CHANNEL OPTICAL-FILTER PHOTODIODE	UNC

28. APPLICATION	29. SPACECRAFT
MET, ATM-PHYS	NIMBUS 3

30. PURPOSE

PRIMARY-TO DETECT VARIATION OF RELATIVE INTENSITY OF SOLAR FLUX IN 5 SPECTRAL BANDS;***SECONDARY-TO MAKE ABSOLUTE MEASUREMENTS OF THE FLUX, TO MEASURE THE RATE OF DECREASE OF FLUX AS THE SATELLITE ENTERS THE EARTH SHADOW NEAR THE POLES, TO MEASURE ATMOSPHERIC OZONE.

31. PRINCIPLES OF OPERATION

THIS EXPERIMENT, SIMILAR TO ONE FLOWN ON NIMBUS D, USES 5 PHOTODIODES TO MONITOR THE FLUX FROM THE SUN IN 5 WAVELENGTH REGIONS. THESE REGIONS ARE AT 1216 A(THE HYDROGEN LYMAN ALPHA LINE), 1600 A WITH 150 A WIDTH, 1800 A WITH 300 A WIDTH, 2100 A WITH 450 A WIDTH, AND 2600 A WITH 600 A WIDTH. OPTICAL FILTERS DETERMINE THE SHORT WAVELENGTH CUTOFF FOR EACH REGION, AND THE CHOICE OF PHOTOCATHODE MATERIAL DETERMINES THE LONG WAVELENGTH CUTOFF. A SOLAR ASPECT SENSOR GIVES THE ANGLE AT WHICH THE SUN'S RAYS STRIKE THE DIODES WITH 7 BIT ACCURACY. USABLE DATA IS OBTAINED OVER A 100 DEG FOV. THE RADIATION INTENSITY IS READ AS THE CURRENT FROM THE PHOTODIODES BY EITHER OF TWO PARALLEL ELECTROMETERS WITH FOUR DECADE RANGES. THERE IS AN AUTOMATIC ZERO SETTING DEVICE FOR THE ELECTROMETERS. THEY ARE CALIBRATED USING 5 CONSTANT CURRENTS SUPPLIED BY A RADIOACTIVE SOURCE (AM 241). AN EXPERIMENT CYCLE TAKES 48 SEC INCLUDING CALIBRATION CHECKS, HOUSEKEEPING CHECKS AND SENSOR DATA. EACH SENSOR IS MONITORED FOR 5 SEC PER CYCLE. WHEN THE S/C IS OVER THE POLAR REGIONS THE EARTH'S ATMOSPHERE ATTENUATES THE UV SEEN BY THE SENSORS. THIS OPACITY MEASUREMENT CAN GIVE COARSE MEASURES OF THE OZONE AND MOLECULAR OXYGEN IN THE STRATOSPHERE.

32. PHENOMENA OBSERVED

ULTRAVIOLET SOLAR RADIATION FLUX

33. MEASUREMENT RANGE

SIGNAL CURRENT FROM 0.1 TO 100 NANOAMPS

34. PRECISION AND ACCURACY

ABSOLUTE ACCURACY OF FLUX MEASUREMENTS WITHIN 20 PERCENT

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
1200. TO 2600. A		

38. FIELD OF VIEW	39. GROUND SWATH
100. DEG	1400 NM DIAM CIRCLE FROM 600 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.7 DEG	7 NM FROM 600 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED CIRCULAR	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

PHOTODIODE DETECTORS, SUN ASPECT SENSOR, ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
SENSITIVE				

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
CONSTANT CURRENTS	DELAYED TELEMETRY	25 MIN PER ORBIT

62. TELEMETRY REQUIREMENTS

30 BIT DIGITAL WORD READ ONCE EVERY SECOND AT 4 KBITS PER SEC.

63. ADVANTAGES AND LIMITATIONS

64. REFERENCES

1) NORMYLE, W.J.: NIMBUS B TO TEST NEW WEATHER SENSORS, IN AVIATION WEEK AND SPACE TECHNOLOGY, MAY 6, 1968, PP. 71-79.***
2) PRESS KIT, NIMBUS B, NASA RELEASE NO: 68-48K, MAY 1968.***3) NIMBUS B COMMAND AND TELEMETRY DIRECTORY, VOL 2, EXPERIMENT SUBSYSTEMS. GENERAL ELECTRIC CO. PHILADELPHIA, PA. AUG. 1967.

65. HISTORICAL REMARKS

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
SATELLITE INFRARED SPECTROMETER	SIRS	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
WARK, DR. D.Q.	NAT ENV SAT CTR, ESSA	301-440-7114
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
HILLEARY, D.T.	NAT ENV SAT CTR, ESSA	301-735-0021

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					OPERATIONAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B. B.	NASA HDQTRS	OSSA/SRN	202-962-0891

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
ESSA	SUITLAND, MARYLAND	04/69	NA

26. INSTRUMENT TYPE	27. SECURITY
SPECTROMETER, 8-CHANNEL IR FASTIE-EBERT FIXED-GRATING	UNC

28. APPLICATION	29. SPACECRAFT
MET	NIMBUS 3

30. PURPOSE

PRIMARY- TO MEASURE THE TEMPERATURE PROFILE FROM THE EARTH'S SURFACE OR CLOUD TOPS TO 15 MILE ALTITUDE.***SECONDARY- TO MEASURE SURFACE TEMPERATURE OR CLOUD TOP TEMPERATURE AND ITS HEIGHT.

31. PRINCIPLES OF OPERATION

THE INSTRUMENT IS A FASTIE-EBERT GRATING INFRARED SPECTROMETER WITH A WEDGE-IMMERSED THERMISTOR BOLOMETER AS DETECTOR AT EACH OF 8 EXIT SLITS. RADIATION IS MONITORED IN 7 INTERVALS (5-8 INV. CM. HALF POWER BANDWIDTHS) IN THE CO2 BAND FROM 13 TO 15 MICRONS AND IN 1 INTERVAL IN THE ATMOSPHERIC WINDOW AT 11.1 MICRONS. A TWO POSITION PLANE MIRROR REFLECTS EITHER A BLACK BODY CALIBRATION SOURCE OR EARTH RADIATION TO A CHOPPER WHICH ALTERNATELY VIEWS THIS RADIATION OR COLD SPACE. FROM THERE THE RADIATION PASSES THRU AN ORDER LIMITING INTERFERENCE FILTER, STRIKES A 25 IN. FOCAL LENGTH SPHERICAL MIRROR, A 5 IN. -1250 LINES/IN. DIFFRACTION GRATING, THE SPHERICAL MIRROR AGAIN, AND FINALLY THE EXIT SLITS. EARTH RADIATION IS GATHERED CONTINUOUSLY FROM A VIEWING ANGLE OF 0.04 STERADIAN (12X12 DEG) CENTERED ON THE NADIR. THIS GIVES DATA ALONG A NORTH-SOUTH STRIP WHOSE PROJECTION ON THE GROUND IS 120 NM WIDE. ADJACENT STRIPS ARE SEPARATED BY ABOUT 1600 NM AT THE EQUATOR. THE 11.1 MICRON DATA GIVES SURFACE OR CLOUD TOP TEMPERATURES. THE 15 MICRON DATA IS USED A GENERATE VERTICAL, TEMPERATURE-PRESSURE PROFILES BY A MATHEMATICAL INVERSION TECHNIQUE. DATA IS ACCUMULATED IN 6 SEC INTERVALS TO GIVE PROFILES EACH 50 MILES ALONG THE STRIP.

32. PHENOMENA OBSERVED

IR RADIATION EMITTED FROM THE EARTH'S ATMOSPHERE, SURFACE, CLOUDS

33. MEASUREMENT RANGE

34. PRECISION AND ACCURACY

TEMP TO 1 DEG K; PRESSURE TO 10 MB

35. SPECTRAL RANGE			36. SPECTRAL RESOLUTION	37. TIME CONSTANT
11.1	TO 15.0	MICRONS	0.6 PERCENT	

38. FIELD OF VIEW	39. GROUND SWATH
12.0 BY 12.0 DEG	120 NM BY 120 NM FROM 600 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
12. DEG	120 NM FROM 600 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED CIRCULAR	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

FIXED-GRATING IR SPECTROMETER, CALIBRATION SOURCE, ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
91 LB	4. CU FT	21 WATTS			

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
SENSITIVE			SENSITIVE	

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
BLK BDY RADIATION SOURCE	DELAYED TELEMETRY	CONTINUOUS

62. TELEMETRY REQUIREMENTS

9 PRIMARY CHANNELS WITH 10 BIT ACCURACY, ALL SAMPLED WITHIN 100 MILLISECONDS AND TELEMETERED TWICE EVERY 16 SECONDS

63. ADVANTAGES AND LIMITATIONS

64. REFERENCES

1) GOLDBERG, I.L.: METEOROLOGICAL IR INSTRUMENTS FOR SATELLITES. PRESENTED AT 13TH ANNUAL TECH SYMP OF SPIE, AUG 1968.***2) NIMBUS B PRESS KIT, NASA RELEASE NO. 68-84K, MAY 1968.***3) MINZNER, R.A. ED: INTERIM REPORT ON SATELLITE METEOROLOGICAL INSTRUMENTS, NASA ERC PM-6713, JUNE 1967.

65. HISTORICAL REMARKS

66. DIAGRAMS

NIMBUS D

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
BACKSCATTERED ULTRAVIOLET RADIATION EXPERIMENT	BUV	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
HEATH, DR. D.F.	GODDARD SPACE FLT CENTER	301-982-6421
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
MATEER, C.L.	NATL CTR FOR ATMOS RES	

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					PROTOTYPE

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B. B.	NASA HDQTRS	OSSA/SRN	202-962-0891

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
NATL CTR FOR ATMOS RES		03/70	

26. INSTRUMENT TYPE	27. SECURITY
SPECTROMETER, EBERT-TYPE GRATING ULTRAVIOLET PHOTOMETRIC	UNC

28. APPLICATION	29. SPACECRAFT
MET	NIMBUS D

30. PURPOSE

PRIMARY- TO MEASURE THE INTENSITY OF ULTRAVIOLET RADIATION BACKSCATTERED BY THE EARTH-ATMOSPHERE SYSTEM IN BOTH SUNLIGHT AND MOONLIGHT IN ORDER TO MONITOR THE SPATIAL DISTRIBUTION OF OZONE.

31. PRINCIPLES OF OPERATION

THE MAIN INSTRUMENT IS A DOUBLE MONOCHROMATER COMPOSED OF TWO EBERT-TYPE MONOCHROMATERS IN TANDEM. EACH HAS A GRATING 64X64 MM WITH 2400 LINES/MM. LIGHT FROM A 0.05 STERADIAN SOLID ANGLE (SUBTENDING A 120X120 NM AREA ON THE EARTH'S SURFACE FROM 600NM) ENTERS THE NADIR POINTING INSTRUMENT THRU A DEPOLARIZING FILTER. A MOTOR-DRIVEN CAM STEP-ROTATES THE GRATINGS TO MONITOR THE INTENSITY OF 12 OZONE ABSORPTION WAVELENGTHS AT 2555, 2735, 2830, 2876, 2922, 2975, 3019, 3058, 3125, 3175, 3312 AND 3398 A WITH A CENTER WAVELENGTH ACCURACY OF 0.2 A AND A BANDPASS OF 10A SET BY THE SLIT SYSTEM. THE DETECTOR IS A PHOTOMULTIPLIER TUBE. FOR BACKGROUND READINGS, A FILTER PHOTOMETER MEASURES THE REFLECTED UV IN A WAVELENGTH REGION (NEAR 3800 A) FREE OF OZONE ABSORPTION. SIGNALS FROM BOTH UNITS ARE READ BY SEPARATE RANGE-SWITCHING ELECTROMETERS WITH 7 DECADE RANGES. UNDER AVERAGE SUNLIGHT CONDITIONS THE SIGNAL IS CALCULATED TO BE 3 MILLIAMP AT 3400 A DOWN TO 0.2 MICROAMP AT 2550 A. A MEASUREMENT CYCLE TAKES 40 SEC INCLUDING 10 SEC FOR CALIBRATION BY ON-BOARD LIGHT SOURCES. ONCE EACH ORBIT THE FOV IS SWITCHED TO MONITOR THE SUN OR MOON DIRECTLY. THE VERTICAL DISTRIBUTION OF OZONE IS OBTAINED BY MATHEMATICAL INVERSION TECHNIQUES.

32. PHENOMENA OBSERVED

ULTRAVIOLET RADIATION FROM THE EARTH'S ATMOSPHERE

33. MEASUREMENT RANGE

SIGNAL CURRENT FROM 0.2 TO 3000 MICROAMPS

34. PRECISION AND ACCURACY

WAVELENGTH TO 0.5 A; INTENSITY TO 2 PERCENT

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
2500. TO 3400. A	0.35 PERCENT	

38. FIELD OF VIEW	39. GROUND SWATH
13. DEG	135 NM DIAM CIRCLE FROM 600 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
13. DEG	135 NM FROM 600 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
2. DEG		MED CIRCULAR	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

SPECTROMETER, PHOTOMETER, ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
32 LB	0.78 CU FT	7 WATTS			

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
SEE ITEM 31	DELAYED TELEMETRY	

62. TELEMETRY REQUIREMENTS

INFORMATION STORED; 13 READINGS WITH 7 BIT ACCURACY, EACH 0.5 SEC. HOUSEKEEPING ALSO.

63. ADVANTAGES AND LIMITATIONS

MOVING PARTS

64. REFERENCES

1) KOEPP-BAKER, N.B.: BUV SUBSYSTEM DIRECTORY (PRELIM VERSION) GENERAL ELECTRIC CORP., PHILADELPHIA, PA.***2) DAVE, J.V. AND HEATH, D.F.: PROPOSAL TO DETERMINE THE SPATIAL DISTRIBUTION OF ATMOSPHERIC OZONE FROM MEASUREMENTS OF ULTRAVIOLET RADIATION BACKSCATTERED BY THE EARTH'S ATMOSPHERE (NOV. 1965).

65. HISTORICAL REMARKS

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
FILTER-WEDGE SPECTROMETER	FWS	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0003

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
HOVIS, DR. W. A.	GODDARD SPACE FLT CENTER	301-982-6465
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					PROTOTYPE

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B. B.	NASA HDQTRS	OSSA/SRN	202-962-0891

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
		03/70	

26. INSTRUMENT TYPE	27. SECURITY
SPECTROMETER, CIRCULAR-WEDGE INTERFERENCE-FILTER INFRARED	UNC

28. APPLICATION	29. SPACECRAFT
MET	NIMBUS D

30. PURPOSE

PRIMARY- TO DETERMINE THE LATERAL DISTRIBUTION OF THE TOTAL WATER VAPOR CONTENT PER UNIT VERTICAL COLUMN.***SECONDARY- TO DETERMINE THE VERTICAL DISTRIBUTION OF WATER VAPOR CONTENT IN ANY PARTICULAR UNIT VERTICAL COLUMN. AND THE LATERAL VARIATION OF THE VERTICAL DISTRIBUTION.

31. PRINCIPLES OF OPERATION

THE INSTRUMENT IS AN IR RADIOMETER WHICH PASSES INCIDENT RADIATION THROUGH A CONTINUOUSLY ROTATING (ONCE EVERY 16 SEC) FILTER WHEEL. THE FILTER WHEEL IS A 2-SEGMENT 100-LAYER INTERFERENCE FILTER WITH THE LAYER THICKNESS LINEARLY INCREASING AS A FUNCTION OF ANGULAR POSITION, CAUSING THE BAND PASS TO SHIFT TOWARD THE LONGER WAVELENGTH. ONE SECTOR TRANSMITS THE 3.2-6.4 MICRON BAND AND THE OTHER THE 1.2-2.4 MICRON BAND. AN IMMERSED LEAD SELENIDE DETECTOR IS USED. INCIDENT RADIATION IS SAMPLED 20 TIMES A SECOND. THE RESULT IS A SPECTRAL INTENSITY PLOT OF 158 POINTS FOR EACH PASSBAND PER REVOLUTION. A TELESCOPE ORIENTED NORMAL TO THE EARTH'S SURFACE COLLECTS ATMOSPHERIC RADIATION FROM A 3 DEG FOV DIRECTLY BELOW THE SATELLITE. AT A 600NM ALTITUDE IN A SUN-SYNCHRONOUS ORBIT, A POLE-TO-POLE STRIP OF ATMOSPHER 31 NM WIDE IS VIEWED ON EACH SATELLITE PASS WITH A 1330 NM SEPARATION BETWEEN SUCCESSIVE STRIPS AT THE EQUATOR. NARROW SPECTRAL REGIONS IN THE CO2 AND H2O ABSORPTION BANDS AT 4.3 AND 6.3 MICRON AND IN A WINDOW REGION ARE OF INTEREST. CALIBRATION IS ACCOMPLISHED BY CHOPPING AGAINST A BLACKBODY OF KNOWN TEMPERATURE, 27+-0.5 DEG C. THE SPECTRA ARE ANALYZED BY THE METHOD OF INVERSION OF RADIATIVE TRANSFER EQUATIONS.

32. PHENOMENA OBSERVED

INFRARED SPECTRAL RADIANCE OF EARTH'S ATMOSPHERE

33. MEASUREMENT RANGE

34. PRECISION AND ACCURACY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
1.2 TO 6.4 MICRON	2.3 PERCENT	

38. FIELD OF VIEW	39. GROUND SWATH
3. DEG	30 BY 30 NM FROM 600 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
3. DEG	30 NM FROM 600 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED CIRCULAR	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

SPECTROMETER, TELESCOPE, 2 DETECTORS, ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
13 LB	0.3 CU FT	6 WATTS			

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
			SENSITIVE	RADIATIVE COOLING

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
SEE ITEM 31	DELAYED TELEMETRY	CONTINUOUS

62. TELEMETRY REQUIREMENTS

298 BITS PER SECOND

63. ADVANTAGES AND LIMITATIONS

LOW COST, LOW POWER DRAIN, SIMPLE INSTRUMENT; RESULTS LIMITED TO LOWER ALTITUDES, HAS MOVING PARTS

64. REFERENCES

1) GARAFOLE, F.: FWS SUBSYSTEM DIRECTORY (PRELIM), GENERAL ELECTRIC CO., PHILADELPHIA, PA., DEC. 1967.***2) MINZNER, R.A., INTERIM REPORT ON SATELLITE METEOROLOGICAL INSTRUMENTS. NASA/ERC REPORT NO. PM-6713, JUNE 1967.

65. HISTORICAL REMARKS

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
IMAGE-DISSECTOR CAMERA SYSTEM	IDCS	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
BRANCHFLOWER, G.	GODDARD SPACE FLT CENTER	301-982-5539
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
	NAS5-9619				FLT MODEL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B. B.	NASA HDQTRS	OSSA/SRN	202-962-0891

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
ITT INDUSTRIAL LABS	FORT WAYNE, INDIANA	03/70	

26. INSTRUMENT TYPE	27. SECURITY
IMAGER, 1-INCH ELECTRICALLY-SCANNING PHOTOCATHODE VISIBLE	UNC

28. APPLICATION	29. SPACECRAFT
MET	NIMBUS D

30. PURPOSE

PRIMARY-TO ACQUIRE HIGH-RESOLUTION PICTURES OF THE EARTH'S DAYTIME CLOUD COVER.

31. PRINCIPLES OF OPERATION

THE IMAGE DISECTOR CAMERA PERFORMS THE FUNCTIONS THAT PREVIOUSLY REQUIRED BOTH AN AVCS AND AN APT. IT HAS ALSO FLOWN ON ATS 3, BUT WITH DIFFERENT OPTICS, AND IS CURRENTLY FLYING ON NIMBUS 3. A SCENE IS OPTICALLY FOCUSED ON THE PHOTOCATHODE AND PHOTOELECTRONS ARE EMITTED FROM THE SURFACE IN PROPORTION TO THE INCIDENT ILLUMINATION. THE PHOTOELECTRONS ARE ACCELERATED TOWARD AND FOCUSED ON A PLANE WHICH CONTAINS A PINHOLE APERTURE AT ITS CENTER. THE ELECTRON IMAGE IS DEFLECTED PAST THE APERTURE BY MEANS OF MAGNETIC DEFLECTION. THE APERTURE SAMPLES THE ELECTRON IMAGE AND A SECONDARY-EMISSION ELECTRON-MULTIPLIER SECTION AMPLIFIES THE SIGNAL BY ABOUT 10 MILLION. THE CAMERA IS USED IN THE LINE SCAN MODE WITH THE SPACECRAFT MOTION ALONG THE ORBITAL TRACK PROVIDING THE OTHER SCAN COMPONENT. NO SHUTTER IS REQUIRED AS THE SENSOR IS A NON-STORAGE TYPE, AND EXPOSURE TO THE SCENE IS CONTINUOUS. THE VERY NARROW BANDWIDTH (1800 HZ) RESULTS IN GENERATION OF A VIDEO SIGNAL WITH THE HIGH NOMINAL S/N OF 40 DB. THE CAMERA-LINE FREQUENCY IS 4 HZ WITH THE FRAME PERIOD BEING 200 SEC. THE LENS APERTURE IS FIXED AT F/3. THE GROUND RESOLUTION IS 1.7 NM AT THE SUBSATELLITE POINT. REALTIME PICTURES CAN BE TRANSMITTED TO APT RECEIVING STATIONS.

32. PHENOMENA OBSERVED

LIGHT REFLECTED FROM THE EARTH'S SURFACE AND CLOUD COVER

33. MEASUREMENT RANGE

100 TO 10,000 FOOT-LAMBERTS

34. PRECISION AND ACCURACY

800 TV LINE RESOLUTION, S/N=40 DB AT 10,000 FOOT-LAMBERTS

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.4 TO 0.7 MICRON		

38. FIELD OF VIEW	39. GROUND SWATH
92.0 BY 7.0 DEG	1300 NM BY 80 NM FROM 600 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.16 DEG	1.7 NM AT CENTER FROM 600 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED	CIRCULAR SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

SPACECRAFT ATTITUDE ERRORS MUST BE HELD TO VERY SMALL VALUES

47. COMPONENTS

IMAGE DISSECTOR, SCANNING APERTURE, 12 STAGE ELECTRON MULTIPLIER

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
14 LB	0.2 CU FT	12 WATTS	1 WATT		

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
	SENSITIVE			

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
	DELAYED AND REALTIME	14 PICTURES/ORBIT

62. TELEMETRY REQUIREMENTS

1 VIDEO CHANNEL (1800 HZ BANDWIDTH), 12 HOUSEKEEPING CHANNELS

63. ADVANTAGES AND LIMITATIONS

HAS APT CAPABILITY; DAYLIGHT USE ONLY.

64. REFERENCES

1) FRANKLIN, W., IDCS SUBSYSTEM DIRECTORY (REVISED).***2) MINZNER, R. A.: INTERIM REPORT ON SATELLITE METEOROLOGY INSTRUMENTS. NASA/ERC REPORT NO. PM-6713, JUNE 1967.

65. HISTORICAL REMARKS

REPLACES AVCS PLUS APT. FLOWN ON ATS 3 AND NIMBUS 3.

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
INFRARED INTERFEROMETER/SPECTROMETER	IRIS	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
HANEL, R.A.	GODDARD SPACE FLT CENTER	301-982-4528
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
CONRATH, DR. B.	GODDARD SPACE FLT CENTER	301-982-4235

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					PROTOTYPE

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B. B.	NASA HDQTRS	OSSA/SRN	202-962-0891

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
TEXAS INSTRUMENTS	DALLAS, TEXAS	03/70	

26. INSTRUMENT TYPE	27. SECURITY
SPECTROMETER, MODIFIED MICHELSON INFRARED INTERFEROMETER	UNC

28. APPLICATION	29. SPACECRAFT
MET	NIMBUS D

30. PURPOSE

PRIMARY- TO DETERMINE THE VERTICAL TEMPERATURE PROFILE, VERTICAL OZONE DISTRIBUTION, VERTICAL WATER VAPOR DISTRIBUTION, AND TEMPERATURE OF EARTH'S SURFACE OR CLOUD TOPS.

31. PRINCIPLES OF OPERATION

THIS IS A TWYMAN-GREEN MODIFICATION OF A MICHELSON INTERFEROMETER SPECTROMETER OPERATING IN THE 6.5 TO 40 MICRON WAVELENGTH REGION. RADIATION FROM A CYLINDER OF ATMOSPHERE, WHOSE BASE ON THE SURFACE OF THE EARTH IS A CIRCLE OF 53 NM IN DIAMETER, IS REFLECTED INTO THE INSTRUMENT FROM A PLANE MIRROR WHICH ROTATES TO PROVIDE IMAGE MOTION COMPENSATION. THE RADIATION IS SPLIT INTO 2 BEAMS, ONE OF WHICH IS REFLECTED FROM A MOVING MIRROR, RECOMBINED AND FOCUSED ONTO A BOLOMETER DETECTOR. INTERFERENCE EFFECTS RESULT FROM THE PATH LENGTH DIFFERENCES IN THE TWO BEAMS AS THE MIRROR MOVES. IT TRAVELS ABOUT 2 MM IN 13 SEC TO GIVE AN INTERFEROGRAM WHICH IS RECORDED ON TAPE. OBSERVATIONS ARE BEGUN 16 SEC APART IN WHICH TIME THE S/C TRAVELS ABOUT 65 NM THUS THERE IS NO OVERLAP IN SUCCESSIVE OBSERVATIONS. AFTER RECORDING 14 INTERFEROGRAMS, TWO CALIBRATION OBSERVATIONS ARE MADE, ONE FOR A REFERENCE BLACKBODY AT 300 K AND ONE FOR OUTER SPACE. A FOURIER TRANSFORMATION, PERFORMED BY DIGITAL COMPUTER MUST BE MADE ON EACH TELEMETERED INTERFEROGRAM TO PRODUCE A SPECTRUM. THEN, TO RELATE THIS TO ATMOSPHERIC CONDITIONS APPROPRIATE SPECTRAL ABSORPTION REGIONS MUST BE CHOSEN AND EMPLOYED IN AN INVERSION OF THE RADIATIVE TRANSFER EQUATIONS.

32. PHENOMENA OBSERVED

REFLECTED AND EMITTED IR ENERGY FROM EARTH AND ITS ATMOSPHERE

33. MEASUREMENT RANGE

34. PRECISION AND ACCURACY

TEMPERATURE TO 2 DEG K; TOTAL WATER VAPOR AND SCALE HEIGHT 5%

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
6.5 TO 40.0 MICRONS	0.32 PERCENT	3. MILLSEC

38. FIELD OF VIEW	39. GROUND SWATH
5. DEG	53 NM DIAM CIRCLE FROM 600 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
5. DEG	53 NM FROM 600 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED CIRCULAR	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

INTERFEROMETER SPECTROMETER, ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
38 LB	0.3 CU FT	12 WATTS		24 WATTS	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
			SENSITIVE	

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
BLK BODY AND COLD SPACE	DELAYED TELEMETRY	CONTINUOUS

62. TELEMETRY REQUIREMENTS

3.75 K-BITS PER SECOND FOR 13 OUT OF 16 SECONDS

63. ADVANTAGES AND LIMITATIONS

NO INFORMATION WITH SOLID CLOUD COVER, LIMITED INFORMATION WITH PARTIAL CLOUD COVER. IMC REQUIRED. MOVING PARTS

64. REFERENCES

1) MINZNER, R.A. ED,: INTERIM REPORT ON SATELLITE METEOROLOGICAL INSTRUMENTS, NASA-ERC PM-6713, JUNE 1967.***2) SILVER, J.: IRIS SUBSYSTEM DIRECTORY, GENERAL ELECTRIC CO., PHILADELPHIA, PA., JUNE 1968.***3) GOLDBERG, I.L.: METEOROLOGICAL IR INSTRUMENTS FOR SATELLITES. PRESENTED AT 13TH ANNUAL SYMPOSIUM OF SPIE, AUG. 68.

65. HISTORICAL REMARKS

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
INTERROGATION, RECORDING, AND LOCATION SYSTEM	IRLS	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
COTE, C. E.	GODDARD SPACE FLT CENTER	301-982-4104
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
NONE		

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					PROTOTYPE

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B. B.	NASA HDQTRS	OSSA/SRN	202-962-0891

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
RADIATION, INC.	MELBOURNE, FLORIDA	03/70	

26. INSTRUMENT TYPE	27. SECURITY
TRANSPONDER, UHF	UNC

28. APPLICATION	29. SPACECRAFT
MET, COMM	NIMBUS D

30. PURPOSE

PRIMARY- TO LOCATE SUCCESSIVE POSITIONS OF EACH UNIT OF A SET OF IN-SITU DATA-GATHERING MODULES (E.G., THE BALLOON INTERROGATION PACKAGE(BIP)); TO RECEIVE AND STORE IN THE S/C THE DATA MEASURED BY EACH MODULE; TO TRANSMIT THE STORED DATA TO A GROUND STATION FOR PROCESSING. THE OBJECTIVE IS TO ESTABLISH A WORLD-WIDE NET FOR OBTAINING WIND AND OTHER METEOROLOGICAL DATA.

31. PRINCIPLES OF OPERATION

THIS INSTRUMENT IS SIMILAR TO THAT FLOWN ON NIMBUS 3. IT CONSISTS OF A TRANSMITTER (401.5 MHZ) WITH A SOLID STATE FINAL STAGE, RECEIVER (466 MHZ), DECODING AND CODING CIRCUITS, RANGE DETECTOR AND MEMORY (100 KBIT). THE DATA MODULES EACH WITH A UNIQUE ADDRESS, OF WHICH THE BALLOON INTERROGATION PACKAGE (BIP) IS AN EXAMPLE, CONTAIN A RECEIVER (401.5 MHZ), DECODING AND CODING CIRCUITS, DATA SENSORS AND A TRANSMITTER (466 MHZ). AS THE S/C PASSES WITHIN RANGE OF A COMMAND AND DATA ACQUISITION STATION (CDA) UP TO 370 COMMANDS CAN BE SENT AND STORED IN THE IRLS MEMORY. A COMMAND CONSISTS OF A TIME FOR AN INTERROGATION AND THE ADDRESS OF THE BIP (OR OTHER MODULE) TO BE CONTACTED. WHEN THE STORED COMMAND TIME AND THE S/C CLOCK TIME COINCIDE, THE S/C IRLS TRANSMITS THE ASSOCIATED BIP ADDRESS. THE BIP RESPONDS AND TRANSMITS ITS SENSOR READINGS. THESE AND THE ROUND TRIP SIGNAL DELAY TIME BETWEEN THE BIP AND THE S/C ARE STORED IN THE IRLS MEMORY. THIS PROCEDURE IS REPEATED FOR EACH STORED COMMAND UNTIL THE CDA INITIATES TRANSMISSION OF THE MEMORY CONTENTS AND THE STORAGE OF NEW COMMANDS IN THE MEMORY. KNOWING THE S/C POSITIONS AND TWO RANGES TAKEN ABOUT 150 SEC APART, THE POSITION OF A MODULE CAN BE FOUND TO WITHIN 2 KM.

32. PHENOMENA OBSERVED

TRANSMISSIONS FROM REMOTE PLATFORMS-BALLOONS, BUOYS, SURFACE PKG

33. MEASUREMENT RANGE

34. PRECISION AND ACCURACY

LOCATION TO +-1.1 NM; DELAY TIME TO 0.625 MICROSEC

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
466. AND 401.5 MHZ	NA	

38. FIELD OF VIEW	39. GROUND SWATH
NA	NA

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED CIRCULAR	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

RECEIVER, TRANSMITTER, ELECTRONICS, MEMORY, ANTENNA

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
25 LB	.3 CU FT	18 WATTS		107 WATTS	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
SOURC/SEN				

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
	DELAYED TELEMETRY	ON COMMAND

62. TELEMETRY REQUIREMENTS

20 CHANNELS: 5 DIGITAL AND 15 ANALOG, SAMPLED BETWEEN 1 AND 16 SECONDS

63. ADVANTAGES AND LIMITATIONS

TOTAL BIP WEIGHT INCLUDING SOLAR-POWER SOURCE IS 10 POUNDS; BIPS NEAR THE EQUATOR MAY NOT RESPOND ON SUCCESSIVE ORBITS

64. REFERENCES

1) JONES, H., IRLS SUBSYSTEM DIRECTORY (PRELIM), GENERAL ELECTRIC CO., PHILADELPHIA, PA., FEB. 1968.***2) MINZNER, R.A.: INTERIM REPORT ON SATELLITE METEOROLOGICAL INSTRUMENTS NASA/ERC REPORT NO. DM-6713, JUNE 8, 1967.

65. HISTORICAL REMARKS

SIMILAR TO THE NIMBUS 3 IRLS

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
MONITOR OF ULTRAVIOLET SOLAR ENERGY	MUSE	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
HEATH, DR. D.F.	GODDARD SPACE FLT CENTER	301-982-6421
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					PROTOTYPE

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B. B.	NASA HDQTRS	OSSA/SRN	202-962-0891

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
ADCOLE CORPORATION	WALTHAM, MASS.	03/70	

26. INSTRUMENT TYPE	27. SECURITY
SPECTROMETER, 6-CHANNEL OPTICAL-FILTER PHOTODIODE	UNC

28. APPLICATION	29. SPACECRAFT
MET, ATM-PHYS	NIMBUS D

30. PURPOSE

PRIMARY-TO DETECT VARIATION OF RELATIVE INTENSITY OF SOLAR FLUX IN 5 SPECTRAL BANDS TO HELP DETERMINE THE DISTRIBUTION OF OZONE IN THE ATMOSPHERE;***SECONDARY- TO MAKE ABSOLUTE MEASUREMENTS OF THE FLUX, TO MEASURE THE RATE OF DECREASE OF FLUX AS THE SATELLITE ENTERS THE EARTH SHADOW NEAR THE POLES, TO MEASURE OZONE AND MOLECULAR OXYGEN HIGH IN THE ATMOSPHERE.

31. PRINCIPLES OF OPERATION

THIS EXPERIMENT, SIMILAR TO ONE FLOWN ON NIMBUS B2, USES 6 PHOTODIODES TO MONITOR THE FLUX FROM THE SUN IN 6 WAVELENGTH REGIONS. THESE REGIONS ARE AT 1216 A (THE HYDROGEN LYMAN ALPHA LINE), 1400 A WITH A 100 A WIDTH, 1600 A WITH A 140 A WIDTH, 1800 A WITH A 300 A WIDTH, 2100 A WITH A 450 A WIDTH, AND 2600 A WITH A 600 A WIDTH. OPTICAL FILTERS DETERMINE THE SHORT WAVELENGTH CUTOFF FOR EACH REGION, AND THE CHOICE OF PHOTOCATHODE MATERIAL DETERMINES THE LONG WAVELENGTH CUTOFF. A SOLAR ASPECT SENSOR GIVES THE ANGLE AT WHICH THE SUN'S RAYS STRIKE THE DIODES WITH 7 BIT ACCURACY. USABLE DATA IS OBTAINED OVER A 100 DEG FOV. THE RADIATION INTENSITY IS READ AS THE CURRENT FROM THE PHOTODIODES BY EITHER OF 2 PARALLEL ELECTROMETERS WITH 4 DECADE RANGES. THERE IS AN AUTOMATIC ZERO SETTING DEVICE FOR THE ELECTROMETERS. THEY ARE CALIBRATED USING 5 CONSTANT CURRENTS SUPPLIED BY A RADIOACTIVE SOURCE (AM 241). AN EXPERIMENT CYCLE TAKES 48 SEC INCLUDING CALIBRATION CHECKS, HOUSEKEEPING CHECKS AND SENSOR DATA. EACH SENSOR IS MONITORED FOR 5 SEC PER CYCLE. THIS DATA WILL BE CORRELATED WITH DATA FROM THE BUV EXPERIMENT TO HELP UNDERSTAND THE SOLAR INFLUENCE ON THE STRATOSPHERE. THE ABSOLUTE ACCURACY OF THE MEASUREMENTS WILL BE 20 PERCENT.

32. PHENOMENA OBSERVED

ULTRAVIOLET SOLAR RADIATION FLUX

33. MEASUREMENT RANGE

SIGNAL CURRENT FROM 0.1 NANOAMP TO 100 NANOAMPS

34. PRECISION AND ACCURACY

ABSOLUTE ACCURACY OF FLUX MEASUREMENT WITHIN 20 PERCENT

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
1200. TO 2600. A		

38. FIELD OF VIEW	39. GROUND SWATH
100. DEG	

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.7 DEG	7 NM FROM 600 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED CIRCULAR	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

PHOTODIODE DETECTORS, ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
9 LB					

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
SENSITIVE				

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
CONSTANT CURRENTS	DELAYED TELEMETRY	25 MIN PER ORBIT

62. TELEMETRY REQUIREMENTS

30 BIT DIGITAL WORD READ ONCE EVERY SECOND AT 4 KBITS PER SEC.

63. ADVANTAGES AND LIMITATIONS

64. REFERENCES

1) NORMYLE, W.J.: NIMBUS B TO TEST NEW WEATHER SENSORS. AVIATION WEEK AND SPACE TECHNOLOGY, MAY 6, 1968, PP. 71-79.***
2) PRESS KIT NIMBUS B, NASA RELEASE NO: 68-48K, MAY 1968.***3 FRANKLIN, W.: SUBSYSTEM DIRECTORY REVISED, GENERAL ELECTRIC CO., PHILADELPHIA, PA.

65. HISTORICAL REMARKS

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
SATELLITE INFRARED SPECTROMETER	SIRS	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
14-CHANNEL	11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
WARK, DR. D.Q.	NAT ENV SAT CTR, ESSA	301-440-7114
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
HILLEARY, D.T.	NAT ENV SAT CTR, ESSA	301-440-7114

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					PROTOTYPE

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B. B.	NASA HDQTRS	OSSA/SRN	202-962-0891

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
		03/70	

26. INSTRUMENT TYPE	27. SECURITY
SPECTROMETER, 14-CHANNEL IR FASTIE-EBERT FIXED-GRATING	UNC

28. APPLICATION	29. SPACECRAFT
MET	NIMBUS D

30. PURPOSE

PRIMARY- TO DETERMINE THE WORLDWIDE 3 DIMENSIONAL DISTRUBUTION OF TEMPERATURE, FROM THE GROUND OR FROM CLOUD TOP TO AN ALTITUDE OF 16 TO 19 NM, TO MEASURE SURFACE TEMPERATURE OR THE CLOUD-TOP TEMPERATURE, AND ITS HEIGHT. TO MEASURE THE THREE-DIMENSIONAL DISTRIBUTION OF WATER VAPOR, FROM THE GROUND UP TO ABOUT 6.5 NM.

31. PRINCIPLES OF OPERATION

THE INSTRUMENT, A MODIFICATION OF THE NIMBUS B2 SIRS, IS A FASTIE-EBERT FIXED-GRATING INFRARED SPECTROMETER WITH THE FOLLOWING FEATURES: (1) A PLANE, LIGHT-COLLECTING MIRROR TO PROVIDE ONE FIXED AND TWO VARIABLE EARTH-VIEWING ANGLES; (2) A BALANCED ROTATING CHOPPING MIRROR WHICH SERVES ALTERNATIVELY TO COLLECT SPACE RADIATION, AND EARTH RADIATION; (3) A SPHERICAL MIRROR OF 12.5-INCH FOCAL LENGTH; (4) A 2.5-INCH WITH 1250 LINES PER INCH DIFFRACTION GRATING; (5) A SET OF 14 EXIT SLITS WITH ASSOCIATED INTERFERENCE FILTERS FOR ORDER LIMITATION, AND 14 WEDGE-IMMERSED OR SIMILAR THERMISTOR BOLOMETERS; AND (6) A BLACKBODY RADIATION SOURCE FOR CALIBRATION PURPOSES. THE 15 MICRON RADIATION DATA IS TRANSFORMED INTO A SINGLE TEMPERATURE-PRESSURE PROFILE BY A MATHEMATICAL INVERSION TECHNIQUE. A SIMILAR RELATED TECHNIQUE YIELDS THE ALTITUDE PROFILE OF WATER VAPOR FROM THE 18 TO 35 MICRON DATA THE 11.1 MICRON DATA COMPARED WITH A BLACKBODY TEMPERATURE CALIBRATION CURVE YIELDS SURFACE OR CLOUD-TOP TEMPERATURES. THE BANDS MONITORED ARE CENTERED AT 11.12, 13.33, 14.01, 14.16, 14.31, 14.45, 14.76, 14.95, 18.82, 22.91, 23.50, 34.31, 33.11, 35.71 MICRONS. DATA IS ACCUMULATED IN 6 SEC INTERVALS TO GIVE PROFILES EACH 50 MILES ALONG THE STRIP.

32. PHENOMENA OBSERVED

IR RADIATION EMITTED FROM THE EARTH'S ATMOSPHERE.

33. MEASUREMENT RANGE

40 TO 190 ERG/SEC/SQ-CM/STERADIAN/WAVE-NO

34. PRECISION AND ACCURACY

TEMPERATURE PLUS-MINUS 1 DEG K, WATER VAPOR TO +-1 PERCENT.

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
11.1 TO 36.0 MICRONS	0.6 PERCENT	6.0 SECONDS

38. FIELD OF VIEW	39. GROUND SWATH
32.0 BY 12.5 DEG	350 NM BY 130 NM FROM 600 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
12.5 DEG	130 NM FROM 600 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED CIRCULAR	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

SPECTROMETER, MIRRORS, BOLOMETERS, ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MT&F
70 LB	2.3 CU FT	30 WATTS			

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
SENSITIVE			SENSITIVE	

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
SEE ITEM 31	DELAYED TELEMETRY	CONTINUOUS

62. TELEMETRY REQUIREMENTS

15 CHANNELS, ALL SAMPLED WITHIN 100 MILSEC EVERY 2-8 SECONDS. 9 BIT ACCURACY

63. ADVANTAGES AND LIMITATIONS

MOVING PARTS

64. REFERENCES

1) GALOPP, D.E., SIRS B SUBSYSTEM DIRECTORY (PPELIM), GENERAL ELECTRIC CO., PHILADELPHIA, PA., DEC. 1967.***2) GOLDBERG, I.: METEOROLOGICAL IR INSTRUMENTS FOR SATELLITES. PRESENTED AT 13TH ANNUAL TECH SYMP OF SPIE, AUG 1968.***3) MINZNER. R.A. (ED): INTERIM REPORT ON SATELLITE METEOROLOGICAL INSTRUMENTS. NASA/ERC PM-6713, JUNE 1967.

65. HISTORICAL REMARKS

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE			2. ACRONYM	3. EXP NO
SELECTIVE CHOPPER RADIOMETER			SCR	
(TITLE CONT.)			4. RESUME DATE	5. VERSION
			11/10/69	0004
6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION		8. TELEPHONE	
HOUGHTON, DR. J. AND	OXFORD UNIVERSITY, ENG.		OX5-9291	
9. CO-INVESTIGATOR	10. ORGANIZATION		11. TELEPHONE	
SMITH, DR. S/JOINT PI	READING UNIVERSITY, ENG.		RE8-4372	
12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					PROTOTYPE
18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE	
SCHARDT, B. B.	NASA HDQTRS	OSSA/SRN	202-962-0891	
22. VENDOR	23. LOCATION		24. FLIGHT DATE	25. LEAD TIME
			03/70	
26. INSTRUMENT TYPE				// SECURITY
RADIOMETER, 3 DUAL-CHANNEL INFRARED				UNC
28. APPLICATION		29. SPACECRAFT		
MET		NIMBUS D		

30. PURPOSE

PRIMARY- TO DETERMINE THE THREE-DIMENSIONAL TEMPERATURE STRUCTURE OF THE EARTH'S ATMOSPHERE THROUGH THE USE OF THE 15 MICRON ABSORPTION BAND OF CO2 ON A GLOBAL BASIS BETWEEN THE GROUND OR HIGHEST CLOUD TOP AND 50-KM ALTITUDE.

31. PRINCIPLES OF OPERATION

THE INSTRUMENT HAS 6 CHANNELS, EACH WITH A FIELD-OF-VIEW OF 10 DEG AND ARE ARRANGED IN 3 UNITS OF 2. THE BASIC SPECTRAL SELECTION IS ACHIEVED BY INTERFERENCE FILTERS OF 2 TYPES. THREE CHANNELS USE FILTERS 4 INV. CM. WIDE, AND 3 USE FILTERS 10 INV. CM. WIDE. FOR THE NARROW BAND CHANNELS, A TECHNIQUE OF SELECTIVE CHOPPING BY CO2 IS USED TO FURTHER DELINEATE THE ENERGY COLLECTED. THE FILTERED RADIATION IS SWITCHED BETWEEN A CELL CONTAINING CO2 AND AN EMPTY CELL. THIS PERMITS ONLY WAVELENGTHS ABSORBED BY CO2 TO BE CHOPPED. BY THIS MEANS, THE ENERGY COLLECTED IS EQUIVALENT TO THAT FROM AN INTERVAL OF 1.3 INV. CM. IN 2 OF THE NARROW CHANNELS THE WEIGHTING FUNCTION IS FURTHER SHARPENED BY ADDING A SMALL AMOUNT OF CO2 AT VERY LOW PRESSURE TO THE EMPTY CELL. TEMPERATURES CAN BE OBTAINED UP TO HEIGHTS OF 27 NM USING THE WEIGHTING FUNCTIONS. FOR LOWER ALTITUDE MEASUREMENTS HEIGHT RESOLUTION IS INCREASED FOR THE REMAINING 1 NARROW AND 3 BROAD CHANNELS BY USING A SINGLE CO2 CELL TO ABSORB THE CENTRAL PORTIONS OF THE LINES. THE OPTICAL SYSTEM CONSISTS OF A MOVABLE MIRROR, CHOPPERS, GERMANIUM LENSES, FILTERS, AND A LIGHT PIPE TO CONDENSE RADIATION ONTO A THERMISTOR BOLOMETER. THE OUTPUT OF EACH CHANNEL IS SAMPLED ONCE EACH SECOND.

32. PHENOMENA OBSERVED

IR RADIATION EMITTED FROM THE EARTH'S ATMOSPHERE

33. MEASUREMENT RANGE

34. PRECISION AND ACCURACY

TEMPERATURE TO +-1 DEG C, ALTITUDE TO +-100 METERS

35. SPECTRAL RANGE			36. SPECTRAL RESOLUTION	37. TIME CONSTANT
14.5 TO 15.0 MICRONS			0.2 PERCENT	
38. FIELD OF VIEW		39. GROUND SWATH		
10. DEG		81 NM DIAM CIRCLE FROM 600 NM ALTITUDE		
40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION			
10. DEG	81 NM FROM 600 NM ALTITUDE			
42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION	
		MED CIRCULAR	SUN-SYNCH RETROGRADE	

46. SPECIAL REQUIREMENTS

THIR DATA REQUIRED FOR CALCULATIONS OF VERTICAL TEMP PROFILES

47. COMPONENTS

3 RADIOMETERS, MIRROR, DETECTOR, ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
34 LB	0.5 CU FT	5 WATTS			

54. INTERFERENCE (RF)	55. INTERFERENCE (MAGNETIC)	56. INTERFERENCE (NUCLEAR)	57. INTERFERENCE (THERMAL)	58. SHIELDING
				SENSITIVE

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
SPECIFIC SEQUENCES	DELAYED TELEMETRY	CONTINUOUS

62. TELEMETRY REQUIREMENTS

6 CHANNELS SAMPLED ONCE EACH SECOND WITH ONE-HALF PERCENT ACCURACY

63. ADVANTAGES AND LIMITATIONS

BETTER SPECTRAL RESOLUTION THAN CONVENTIONAL SPECTROMETERS OR INTERFEROMETERS. LIMITED TO ABOVE CLOUDS.

64. REFERENCES

1) SMITH, E.W., SCR SUBSYSTEM DIRECTORY (PRELIM) GENERAL ELECTRIC CO., PHILADELPHIA, PA., FEBRUARY 1968.***2) MINZNER, R.A.: INTERIM REPORT ON SATELLITE METEOROLOGICAL INSTRUMENTS. NASA/ERC REPORT NO. PM-6713, JUNE 1967.***3) GOLDBERG, I.L.: MET IR INSTRUMENTS FOR SATELLITES. PRESENTED AT 13TH ANN TECH SYMP OF SPIE, AUG 19, 1968.

65. HISTORICAL REMARKS

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
TEMPERATURE/HUMIDITY INFRARED RADIOMETER	THIR	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
MCCULLOCH, A.W.	GODDARD SPACE FLT CENTER	301-982-4347
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
GOLDBERG, I.L.	GODDARD SPACE FLT CENTER	301-982-4347

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS

18. MONITOR	19. AGENCY	20. PCM OFFICE	21. TELEPHONE
SCHARDT, B. B.	NASA HDQTRS	OSSA/SRN	202-962-0891

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
		03/70	

26. INSTRUMENT TYPE	27. SECURITY
RADIOMETER, 2-CHANNEL IR HIGH-RESOLUTION SCANNING	UNC

28. APPLICATION	29. SPACECRAFT
MET, ERSP	NIMBUS D

30. PURPOSE

PRIMARY-TO PROVIDE NIGHT AND DAY TIME RESOLUTION, IR TEMPERATURE MAPS OF CLOUDS, LAND, AND OCEAN SURFACE OF THE EARTH.***SECONDARY- TO PROVIDE SYNOPTIC HUMIDITY PATTERNS. TO TRY TO TRACE AIR MASS BOUNDARIES, VERTICAL MOTIONS AND JET STREAMS.***TERTIARY- TO PROVIDE SUPPORTING DATA FOR OTHER EXPERIMENTERS.

31. PRINCIPLES OF OPERATION

THIS RADIOMETER LIKE THE HRIR IS A SCANNING RADIOMETER. THE SCAN IS ACCOMPLISHED BY A PLANE MIRROR ROTATING AT 48 RPM. RADIATION FROM THE SCANNING MIRROR IS COLLECTED AND FOCUSED BY A CASSEGRAINIAN TELESCOPE WITH A 5 INCH PRIMARY MIRROR. A DICHROIC BEAM SPLITTER AND FILTERS THEN DIVIDE THE BEAM INTO 2 CHANNELS, A 6.5-7.0 MICRON CHANNEL FOR WATER VAPOR MEASUREMENTS AND A 10.5-12.5 MICRON CHANNEL FOR SURFACE OR CLOUD TOP TEMPERATURE MEASUREMENTS. IMMERSED THERMISTOR BOLOMETERS ARE THE DETECTORS IN BOTH CHANNELS. DURING A SCAN PERIOD OF 1.25 SEC, THERE IS A SYNC SIGNAL, A STEPPED VOLTAGE CALIBRATION SIGNAL, A SCAN OF COLD SPACE FOR A ZERO LEVEL, THE SCAN OF EARTH, ANOTHER SPACE SCAN, AND A HOUSING SCAN TO GIVE A WARM BODY CALIBRATION POINT. THERE IS NO RADIATION CHOPPING IN THIS INSTRUMENT. THE SWEEP RATE AND THE FIELD OF VIEW ARE CHOSEN SO THAT CONTIGUOUS SCANNING OCCURS ALONG THE SUBSATELLITE TRACK WITH INCREASING OVERLAP TOWARD THE HORIZON. THE 11 MICRON CHANNEL HAS A 0.4 DEG (7.0 MILLIRAD) FOV WHICH GIVES A 4.2 NM RESOLUTION FROM A 600 NM ORBIT. THE 6-MICRON CHANNEL HAS A 1.2 DEGREE (21 MILLIRADIANS) FIELD OF VIEW GIVING A 12.6 NM RESOLUTION FROM A 600 NM ORBIT.

32. PHENOMENA OBSERVED

IR RADIATION FROM THE EARTH'S SURFACE AND CLOUDS

33. MEASUREMENT RANGE

185 TO 300 DEG KELVIN

34. PRECISION AND ACCURACY

+-7 K DEG

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
6.5 TO 12.5 MICRONS		2.0 MILLSEC

38. FIELD OF VIEW	39. GROUND SWATH
SEE ITEM 31	LIMB-TO-LIMB (3800 NM) FROM 600 NM ALT

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
SEE ITEM 31	SEE ITEM 31

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
1.0 DEG		MED CIRCULAR	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

INTERFERENCE FILTER RADIOMETER, ELECTRONICS, MIRRORS, TELESCOPE

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
20 LB	0.5 CU FT	9 WATTS			

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
			SENSITIVE	

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
BLK BODY AND COLD SPACE	DELAYED AND REALTIME	CONTINUOUS

62. TELEMETRY REQUIREMENTS

630 HZ INFORMATION BANDWIDTH

63. ADVANTAGES AND LIMITATIONS

BETTER S/N THAN HRIR, CAN GIVE CIRRUS CLOUD CONTENT; LIMITED TO CLOUD-TOP DATA

64. REFERENCES

1) KAHN, W.: THIR SUBSYSTEM DIRECTORY (PRELIM), GENERAL ELECTRIC CO., NOV. 1967.***2) GOLDBERG, I.L., METEOROLOGICAL INFRARED INSTRUMENTS FOR SATELLITES. GIVEN AT 13TH ANNUAL TECH. SYMP. OF SOC. PHOTO-OPTICAL ENGR., AUG 19-23, 1968.***3) NIMBUS D EXPERIMENTER PROGRAM REVIEW, 25-26 OCT. 1967.

65. HISTORICAL REMARKS

SIMILAR TO HRIR

66. DIAGRAMS

NIMBUS E

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE		2. ACRONYM	3. EXP NO
ELECTRICALLY-SCANNING MICROWAVE RADIOMETER		ESMR	E12
(TITLE CONT.)		4. RESUME DATE	5. VERSION
		11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
NORDBERG, DR. W.	GODDARD SPACE FLT CENTER	301-982-5003
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
THADDEUS, DR. P.	GODDARD INST SPACE SCI	212-866-3600

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
			01/69		PRELIM DSGN

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B. B.	NASA HDQTRS	OSSA/SRN	202-962-0891

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
SPACE GENERAL CORP	EL MONTE, CALIFORNIA	06/72	30 MONTHS

26. INSTRUMENT TYPE	27. SECURITY
RADIOMETER, 19.35-GHZ ELECTRONICALLY-SCANNING MICROWAVE	UNC

28. APPLICATION	29. SPACECRAFT
MET, GEOP, OCEAN	NIMBUS E

30. PURPOSE

PRIMARY- TO MAP GLOBALLY AND CONTINUOUSLY THE THERMAL RADIATION EMITTED BY THE EARTH'S SURFACE AND ATMOSPHERE AT A FREQUENCY OF 19.35 GHZ.*** SECONDARY - TO DEMONSTRATE THE FEASIBILITY OF DEPLOYED PHASED-ARRAY ANTENNAS.

31. PRINCIPLES OF OPERATION

THE RADIOMETER WILL BE USED TO MEASURE PRECISELY THE INTENSITY OF 19.35 GHZ THERMAL RADIATION. THE VIEWING DIRECTION OF THE ANTENNA IS ELECTRONICALLY SCANNED PLUS AND MINUS 50 DEGREES FROM THE NADIR NORMAL TO THE SPACECRAFT GROUND TRACK, PRODUCING A BRIGHTNESS TEMPERATURE MAP OF THE SURFACE OF THE EARTH AND ITS ATMOSPHERE UNDER THE SPACECRAFT. THIS SCANNING CONSISTS OF 78 DISCRETE VIEW POSITIONS AND IS CONTROLLED BY AN INTERNAL COMPUTER. ANGULAR SEPARATION OF VIEW POSITIONS ALLOWS AN 8.5 PERCENT OVERLAP. THE ANTENNA THERMAL TEMPERATURE MUST BE MEASURED. CALIBRATION IS ACHIEVED WITH TWO REFERENCE SOURCES, ONE AT 338 DEGREES KELVIN, THE OTHER NEAR 50 DEGREES KELVIN (A SPACE-VIEWING HORN). THE 90 BY 90 CENTIMETER ANTENNA IS DEPLOYED AFTER ORBIT IS ACHIEVED. THE ANGULAR RESOLUTION OF THE ANTENNA WILL BE 1.4 DEGREES AT THE 3 DB POINTS AT THE BROADSIDE SETTING AND 1.5 DEGREES AT THE MAXIMUM SCAN POSITIONS OF PLUS AND MINUS 50 DEGREES.

32. PHENOMENA OBSERVED

HORIZONTALLY POLARIZED TELLURIC THERMAL EMISSIONS AT 19.35 GHZ

33. MEASUREMENT RANGE

DYNAMIC TEMPERATURE RANGE= 50 TO 330 DEGREES K

34. PRECISION AND ACCURACY

RMS TEMP WITHIN 0.5 DEG K; ABSOLUTE TEMP WITHIN 2 DEG K

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
19.35 GHZ	3.10 PERCENT	

38. FIELD OF VIEW	39. GROUND SWATH
100. BY 1.4 DEG	1400 KM BY 15 KM FROM 600 KM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
1.4 DEG	17 KM FROM 600 KM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

RADIOMETER, RECEIVER, ANTENNA, CALIBRATION TEMPERATURE SOURCES

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
55 LB	1.4 CU FT	25 WATTS	NA	NA	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
SENSITIVE	SENSITIVE	NONE	SENSITIVE	INTEGRAL

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
TWO REFERENCE SOURCES	DELAYED TELEMETRY	CONTINUOUS

62. TELEMETRY REQUIREMENTS

10 BIT WORD READ EACH 25 MILLISECONDS. SERIAL READOUT.

63. ADVANTAGES AND LIMITATIONS

HIGH SPATIAL RESOLUTION; ANTENNA SIDELOBE SUPPRESSION TO EXCEED 95 PERCENT. ANTENNA DESIGN AND DEPLOYMENT MOST CRITICAL

64. REFERENCES

1) NORDBERG, W.: PROPOSAL FOR MAPPING EARTH RADIATION AND CLOUD STRUCTURE WITH AN ELECTRICALLY SCANNING MICROWAVE RADIOMETER, GSFC.***2) CATOE, ET AL: PRELIMINARY RESULTS FROM AIRCRAFT FLIGHT TESTS OF AN ELECTRICALLY SCANNING MICROWAVE RADIOMETER, NASA X-622-67-352, AUG 67.***3) TOBIN, M.: SUPPORT DATA FOR CONVAIR 990 MET FLIGHT 2, NASA X-622-67-450, SEP 67.

65. HISTORICAL REMARKS

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
INFRARED TEMPERATURE-PROFILE RADIOMETER	ITPR	E06
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
SMITH, W. L.	ENVIRON SCI SERV ADMIN	
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
WARK, D. Q.	ENVIRON SCI SERV ADMIN	

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					PRELIM DSGN

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B.	NASA HDQTRS	OSSA/SAN	202-962-0891

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
SANTA BARBARA RES CENTER	GOLETA, CALIFORNIA		40 MONTHS

26. INSTRUMENT TYPE	// SECURITY
RADIOMETER, 6-CHANNEL STEP-SCANNING INFRARED (MODIFIED MRIR)	PRO

28. APPLICATION	29. SPACECRAFT
MET	NIMBUS E

30. PURPOSE

PRIMARY-. TO TEST AN IR RADIOMETER WHICH IS DESIGNED TO MEET THE ENGINEERING AND SCIENTIFIC DEMANDS OF AN OPERATIONAL REMOTE TEMPERATURE SOUNDER***SECONDARY-TO DEVELOP A TECHNIQUE FOR DERIVING THREE-DIMENSIONAL TEMPERATURE AND MOISTURE OF THE ATMOSPHERE FOR OPERATIONAL FORECASTS BY THE MID 1970'S.

31. PRINCIPLES OF OPERATION

THE INSTRUMENT IS BEING DESIGNED ALONG THE GENERAL LINES OF THE NIMBUS 2 MEDIUM RESOLUTION INFRARED RADIOMETER (MRIR). IT WILL MEASURE INFRARED RADIATION EMITTED FROM THE EARTH IN FOUR SPECTRAL INTERVALS IN THE 15-MICRON CARBON-DIOXIDE BAND, ONE INTERVAL IN THE ROTATIONAL WATER VAPOR BAND AND ONE INTERVAL IN THE 11.1-MICRON WINDOW. IT WILL VIEW THE EARTH SUCCESSIVELY AT 29 DIFFERENT VIEWING ANGLES DISTRIBUTED SYMMETRICALLY ABOUT EITHER SIDE OF THE NADIR AND IN A PLANE PERPENDICULAR TO THE SUB-ORBITAL TRACK. 29 GEOGRAPHICALLY INDEPENDENT RESOLUTION ELEMENTS WILL BE MEASURED IN A SINGLE STRIP. AS THE SATELLITE ORBITS, THE RADIOMETER WILL SAMPLE 29 OF THESE STRIPS AND THUS FORM A 29 X 29 MATRIX CONSISTING OF 841 INDEPENDENT RESOLUTION ELEMENTS. THE DATA FROM THIS 29 X 29 MATRIX WILL THEN BE USED TO DERIVE THE THREE DIMENSIONAL TEMPERATURE AND MOISTURE STRUCTURE FOR THAT AREA BY INVERTING THE RADIATIVE TRANSFER EQUATION USING NUMERICAL AND MATHEMATICAL TECHNIQUES. THE STATISTICAL FLUCTUATIONS OF THE RADIATION DATA FROM THE INDEPENDENT RESOLUTION ELEMENTS WILL BE UTILIZED IN THE SOLUTION TO ACCOUNT FOR THE ATTENUATION OF THE MEASURED RADIATION BY CLOUDS. THE DATA ACQUISITION PERIOD FOR EACH FRAME WILL BE ABOUT 4.1 MINUTES.

32. PHENOMENA OBSERVED

IR ENERGY EMITTED FROM THE SURFACE AND ATMOSPHERE OF THE EARTH

33. MEASUREMENT RANGE

0 - 200 ERG-CM/SQ-CM/SEC/STERADIAN

34. PRECISION AND ACCURACY

BETTER THAN 0.3 ERG-CM/SQ-CM/SEC/STERADIAN

35. SPECTRAL RANGE		36. SPECTRAL RESOLUTION	37. TIME CONSTANT
11.0	22.0 MICRONS		

38. FIELD OF VIEW	39. GROUND SWATH
74. BY 2.5 DEG	905 NM BY 26 NM FROM 600 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
2.5 DEG	26 NM FROM 600 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED	

46. SPECIAL REQUIREMENTS

15 AUXILIARY TEMPERATURES AND VOLTAGES MONITORED

47. COMPONENTS

RADIOMETER WITH ASSOCIATED OPTICS PLUS ELECTRONIC PACKAGE

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
35 LB	0.84 CU FT	25 WATTS			

54. EM INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
			SENSITIVE	0 TO 40 DEG C.

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
BLACK BODY; SPACE VIEW	DELAYED TELEMETRY	CONTINUOUS

62. TELEMETRY REQUIREMENTS

IR DATA - 6 10-BIT CHANNELS 4 TIMES PER SECOND; BLACKBODY - ONE 10-BIT CHANNEL; HOUSEKEEPING - 15 CHANNELS ONCE EVERY 1 TO 6 MINUTES WITH 1 PER CENT ACCURACY.

63. ADVANTAGES AND LIMITATIONS

OBSERVATIONS OVER BROKEN CLOUDS MAY BE USED TO DETERMINE TEMPERATURE PROFILE DOWN TO GROUND; MOVING PARTS.

64. REFERENCES

1) SMITH, W.L.: MEASUREMENT OF ATMOSPHERIC TEMPERATURE AND HUMIDITY PROFILES WITH AN INFRARED TEMPERATURE PROFILE RADIOMETER, ESSA PROPOSAL, FEB 68.***2) CHANEY, ET AL: TECH REPORT UNDER CONTRACT NASR-54(03).

65. HISTORICAL REMARKS

SIMILAR TO THE NIMBUS 2 MRIR.

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
IONOSPHERE ELECTROSTATIC PROBE	IEP	E30
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
BRACE, L.H.	GODDARD SPACE FLT CENTER	301-982-4575
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
FINDLAY, J.A.	GODDARD SPACE FLT CENTER	301-982-4574

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
			01/69		PRELIM DSGN

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B. B.	NASA HDQTRS	OSSA/SRN	202-962-0891

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
		06/72	36 MONTHS

26. INSTRUMENT TYPE	27. SECURITY
COUNTER, ELECTROSTATIC CYLINDRICAL PLASMA ELECTRON CURRENT	UNC

28. APPLICATION	29. SPACECRAFT
PLAN-ATM	NIMBUS E

30. PURPOSE

PRIMARY-TO MEASURE THE LONG PERIOD VARIATIONS IN ELECTRON TEMPERATURE AND CONCENTRATION WHICH OCCUR IN THE IONOSPHERE.

31. PRINCIPLES OF OPERATION

THE UPPER IONOSPHERE IS HEATED IN THE DAYTIME BY PHOTO ELECTRONS WHICH ESCAPE THE LOWER IONOSPHERE, AT HIGHER LATITUDES THE IONOSPHERE MAY ALSO BE HEATED BOTH DAY AND NIGHT BY PARTICLE PRECIPITATION, AND OTHER SOURCES. AT NIGHT, HEAT IS CONDUCTED DOWNWARD FROM THE RESERVOIR OF ENERGY STORED IN THE PROTONOSPHERE. THESE VARIATIONS OF HEATING WITH LATITUDE AND TIME OF DAY ARE REFLECTED IN THE ELECTRON (AND ION) TEMPERATURES AND THEIR SPATIAL AND TEMPORAL VARIATIONS. IT IS EXPECTED THAT THE CONTINUOUS COVERAGE OF THE MIDDAY AND MIDNIGHT SECTORS WILL PERMIT DETAILED RESOLUTION OF THE SEASONAL AND 27 DAY COMPONENTS OF THIS VARIATION. THE EXPERIMENT CONSISTS OF A LONG, THIN WIRE COLLECTOR THAT IS MOUNTED ON A FORWARD LOOKING EXTERIOR SURFACE OF THE SATELLITE. A SAWTOOTH VOLTAGE IS APPLIED TO THE COLLECTOR (-3 TO +5 VOLTS), AND THE RESULTING ELECTRON CURRENT FROM THE PLASMA IS INTERPRETED IN TERMS OF ELECTRON TEMPERATURE AND CONCENTRATION. TWO COLLECTORS MAY BE USED FOR CALIBRATION PURPOSES.

32. PHENOMENA OBSERVED

ELECTRON CURRENT FROM THE PLASMA

33. MEASUREMENT RANGE

NO OF ELECTRONS = 10 TO 100,000/CC; TEMP = 500 TO 10,000 DEG K

34. PRECISION AND ACCURACY

NO OF ELECTRONS WITHIN 5 PERCENT; TEMPERATURE WITHIN 10 PERCENT

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
NA	NA	NA

38. FIELD OF VIEW	39. GROUND SWATH
NA	NA

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
NA	NA

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
NA	NA	MED	CIRCULAR SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

EXTERNAL MOUNT, FORWARD LOOKING IN TERMS OF SPACECRAFT MOTION

47. COMPONENTS

WIRE COLLECTOR, ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
3 LB	0.15 CU FT	2 WATTS	NONE	2 WATTS	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
NONE	NONE	NONE	NONE	NONE

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
CURRENT	DELAYED TELEMETRY	MIDDAY & MIDNIGHT

62. TELEMETRY REQUIREMENTS

4 CHANNELS AT 5 WORD/SEC; 6 CHANNELS AT 1 WORD/SEC; 2 CHANNELS AT 1/16 WORD/SEC.

63. ADVANTAGES AND LIMITATIONS

THE NIMBUS ORBIT IS UNIQUELY SUITED FOR IONOSPHERIC MEASUREMENTS

64. REFERENCES

1) BRACE, L.H. AND FINDLAY, J.A.: PROPOSAL FOR ELECTROSTATIC PROBE STUDIES OF THE IONOSPHERE IN A CIRCULAR SUN-SYNCHRONOUS ORBIT, GSFC, 2968.***2) BRACE, L.H. AND SPENCER, N.W., J.G.R., V. 69, 4486, 1964.***3) MAYR, H.G., ET AL, J.G.R., V. 72, 4391, 1967.***4) BRACE, L.H., ET AL, J.G.R., V. 72, 265, 1967.

65. HISTORICAL REMARKS

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
MICROWAVE SPECTROMETER	MS	E07
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
STAELIN, DR. D.H.	MASS INST OF TECHNOLOGY	617-864-6900-X3711
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
BARATH, F. T., ET AL	JET PROPULSION LAB	213-354-3025

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
			01/69		PRELIM DSGN

18. MONITOR	19. AGENCY	20. POM OFFICE	21. TELEPHONE
SCHARDT, B. B.	NASA HDQTRS	OSSA/SRN	202-962-0891

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
JET PROPULSION LAB	PASADENA, CALIFORNIA	06/72	36 MONTHS

26. INSTRUMENT TYPE	27. SECURITY
RADIOMETER, 5-CHANNEL DICKE SUPERHETERODYNE MICROWAVE	UNC

28. APPLICATION	29. SPACECRAFT
MET	NIMBUS E

30. PURPOSE

PRIMARY- TO DEMONSTRATE THE CAPABILITIES AND LIMITATIONS OF MICROWAVE SENSORS FOR MEASURING TROPOSPHERIC TEMPERATURE PROFILES, WATER VAPOR ABUNDANCE, AND CLOUD WATER CONTENT.*** SECONDARY - TO SUPPLEMENT IR SENSORS IN GATHERING DATA FOR WEATHER PREDICTION PURPOSES, ESPECIALLY OVER CLOUD-COVERED REGIONS OF THE EARTH.

31. PRINCIPLES OF OPERATION

THE INSTRUMENT,VIEWING THE NADIR CONTINUOUSLY,WILL MEASURE THERMAL RADIATION AT FIVE WAVELENGTHS, 22.2, 31.4, 53.65, 60.82, AND 64.47 GHZ, NEAR THE 5-MM OXYGEN RESONANCE AND THE 1.35-CM WATER-VAPOR RESONANCE BANDS. EACH FREQUENCY IS AFFECTED TO A DIFFERENT DEGREE BY THE TERRESTRIAL SURFACE, CLOUDS, PRECIPITATION, WATER-VAPOR, AND TEMPERATURE PROFILE. THROUGH CAREFUL INTERPRETATION, MOST OF THESE METEOROLOGICAL PARAMETERS CAN BE SEPARATELY ESTIMATED. THE THREE CHANNELS NEAR 5-MM PRIMARILY MEASURE THE VERTICAL ATMOSPHERIC-TEMPERATURE PROFILE. THE TWO CHANNELS NEAR 1.0-CM BAND PERMIT WATER-VAPOR AND CLOUD-WATER CONTENT OVER THE OCEAN TO BE ESTIMATED SEPARATELY BECAUSE THE 0.9-CM CHANNEL IS ABOUT TWICE AS SENSITIVE TO CLOUDS AS THE 1.4-CM CHANNEL,BUT IS ONLY 0.4 TIMES AS SENSITIVE TO WATER-VAPOR.OVER LAND THE TWO WATER-VAPOR CHANNELS WILL YIELD AN ESTIMATE OF SURFACE TEMPERATURE, ONCE THE SURFACE EMISSIVITY HAS BEEN CALIBRATED BY COMPARISON WITH DIRECT TEMPERATURE MEASUREMENTS.THE THREE OXYGEN RADIOMETERS SHARE A COMMON SIGNAL ANTENNA AND A COMMON REFERENCE ANTENNA. BOTH WATER-VAPOR RADIOMETERS HAVE THEIR OWN SIGNAL AND REFERENCE ANTENNAS.THE RADIOMETERS ARE CALIBRATED BY SEQUENTIAL OBSERVATION OF THE SIGNAL, REFERENCE, AND BLACK-BODY.

32. PHENOMENA OBSERVED

ATMOSPHERIC AND SURFACE RADIATION IN THE 1-CM BANDS

33. MEASUREMENT RANGE

RADIANT TEMPERATURE FROM 0 TO 400 DEGREES KELVIN

34. PRECISION AND ACCURACY

TEMP-2 DEG K; WATER-VAPOR-0.1 GM/SQ CM; CLOUDS-0.04 GM/SQ CM

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.466 TO 1.35 CM		

38. FIELD OF VIEW	39. GROUND SWATH
9.0 DEG	100 NM DIAM CIRCLE FROM 600 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
1.0 DEG	1.0 DEG/SEC	MED	HIGH

46. SPECIAL REQUIREMENTS

CALIBRATION REFERENCE ANTENNAS MUST HAVE UNOBSTRUCTED SKY VIEW

47. COMPONENTS

RADIOMETERS (5), ANTENNAS (3 SETS), ASSOCIATED ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
50 LB	1.33 CU FT	35 WATTS	NONE	40 WATTS	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
SENSITIVE			SENSITIVE	-10 TO +65 DEG C

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
REFERENCE, BLACK BODY	DELAYED TELEMETRY	CONTINUOUS

62. TELEMETRY REQUIREMENTS

60 BPS

63. ADVANTAGES AND LIMITATIONS

TECHNIQUE IS NOT LIMITED TO SUN ANGLE CONSIDERATIONS OR CLOUD FORMATIONS.

64. REFERENCES

1) PROPOSAL FOR MICROWAVE SPECTROMETER, FEB 68.***2) MEEKS, M.L. AND LILLY, A.E.: J.G.R. V.68, P.1683, (1963).***3) LENOIR, W.B.: PHD THESIS MIT, (1965).***4) STAELIN, D.H.: J.G.R. V.71 P.2875 (1966).

65. HISTORICAL REMARKS

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
POSITIVE-ION COMPOSITION SPECTROMETER	PICS	E31
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
TAYLOR, H.A.	GODDARD SPACE FLT CENTER	301-982-6610
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
BRINTON, H.C.	GODDARD SPACE FLT CENTER	301-982-4253

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					PRELIM DSGN

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B.	NASA HDQTRS	OSSA/SRN	202-962-0891

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
GODDARD SPACE FLT CENTER	GREENBELT, MARYLAND		21 MONTHS

26. INSTRUMENT TYPE	27. SECURITY
SPECTROMETER, BENNETT RADIO-FREQUENCY MASS	UNC

28. APPLICATION	29. SPACECRAFT
PART-FLD	NIMBUS E

30. PURPOSE

PRIMARY-TO INVESTIGATE THE GLOBAL ATMOSPHERIC ION COMPOSITION. EMPHASIS WILL BE PLACED ON THE INVESTIGATION OF MECHANISMS RESPONSIBLE FOR THE PRONOUNCED VARIABILITY OF THE COMPOSITION OF THE ATMOSPHERE. MAGNETIC STORM DATA IS OF PARTICULAR INTEREST.*** SECONDARY-TO EVALUATE ADVANCED MEASUREMENT TECHNOLOGY, IN THE FORM OF ON-BOARD PROCESSING OF COMPLEX ION SPECTRA.

31. PRINCIPLES OF OPERATION

A BENNETT RADIO FREQUENCY MASS SPECTROMETER WILL BE OPERATED IN EITHER OF TWO PRIMARY MODES FOR MEASURING THERMAL POSITIVE IONS; IN MODE A THE SPECTROMETER WILL SEARCH THE ENTIRE ION MASS RANGE (1-20 AMU) WITH A SWEEP PERIOD OF APPROXIMATELY 10 SECONDS. AS THE SPECTROMETER SWEEP VOLTAGE REACHES THE APPROPRIATE RESONANCE LEVEL, AMBIENT ATMOSPHERIC IONS OF A GIVEN MASS ARE SELECTIVELY PASSED THROUGH THE SPECTROMETER TUBE AND DETECTED IN THE FORM OF AN ANALOG ION CURRENT. THE COLLECTED ION CURRENT WILL BE AMPLIFIED BY A SERIES OF 5 DECADE AMPLIFIERS AND SUMMED INTERNALLY TO PRODUCE A SINGLE, LOGARITHMIC CHANNEL, WHICH CONSTITUTES THE PRIMARY ANALOG DATA OUTPUT FROM THE EXPERIMENT. A SECOND, NEARLY SIMULTANEOUS DIGITAL DATA OUTPUT IS DERIVED FROM A "DIGITAL PEAK DETECTOR" WHICH INTERROGATES THE LOGARITHMIC ANALOG CHANNEL ONCE EACH SECOND, TO DETERMINE (A) THE AMPLITUDE AND (B) THE SWEEP VOLTAGE 'POSITION' OF THE MOST PROMINENT ION PEAKS. IN MODE B, THE SELECTIVE SWEEP MODE, THE SPECTROMETER WILL SEARCH ANY ONE OF THREE SEPARATE SPECTRAL REGIONS, WHICH WILL BRACKET THE SWEEP LOCATIONS OF 1 AMU(H+), 4 AMU(HE+), AND 14 AND 16 AMU (N+ AND O+). THE PERIOD OF THE SELECTIVE SWEEP WILL BE APPROXIMATELY 2 SECONDS.

32. PHENOMENA OBSERVED

THERMAL POSITIVE IONS IN THE UPPER ATMOSPHERE

33. MEASUREMENT RANGE

MASS RANGE=1-20 AMU; SENSITIVITY FROM 10 TO 1,000,000 IONS/CU CM

34. PRECISION AND ACCURACY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
1. TO 20.	1 IN 20 AMU	

38. FIELD OF VIEW	39. GROUND SWATH
. DEG	NA

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.1 DEG	70 KM ALONG ORBIT (MODE A); 15 KM ALONG ORBIT (MODE B)

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED	HIGH POSIGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

MASS SPECTROMETER, ASSOCIATED ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
10 LB	0.37 CU FT	7 WATTS		7 WATTS	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
	SENSITIVE	SENSITIVE	SENSITIVE	TEMP RANGE 0 TO 50 DEG C

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
	REALTIME TELEMETRY	WHENEVER POSSIBLE

62. TELEMETRY REQUIREMENTS

5 CHANNELS-5 SAMPLES/SEC FOR ANALOG SPECTRUM; 1 CHANNEL-5 SAMPLES/SEC FOR SWEEP; 2 CHANNELS-1 SAMPLE/SEC FOR PEAK SELECTOR; 10 CHANNELS-1 SAMPLE/16 SEC FOR PARAMETRIC VOLTAGE MONITORS.

63. ADVANTAGES AND LIMITATIONS

BASED ON SUCCESS OF SIMILAR OGO-4 EXPERIMENT IN JULY, 1967

64. REFERENCES

1) TAYLOR, H.A., ET AL: PROPOSAL FOR A POSITIVE ION COMPOSITION EXPERIMENT FOR NIMBUS E, GSFC.***2) TAYLOR, H.A., ET AL: POSITIVE ION COMPOSITION IN THE MAGNETIONOSPHERE OBTAINED FROM THE OGO-A ION COMPOSITION IN THE MAGNETOSPHERE OBTAINED FROM THE OGO-A

65. HISTORICAL REMARKS

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
SELECTIVE CHOPPER RADIOMETER	SCR	E05
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
HOUGHTON, DR.J. AND	CLARENDON LAB,OXFORD,ENG	OX5-9291
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
SMITH, DR.S/JOINT PI	READING UNIV,READING,ENG	RE8-4372

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					PRELIM DSGN

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B.	NASA HDQTRS	OSSA/SRN	202-962-0891

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
ELLIOTT-AUTOMATION	ENGLAND		30 MONTHS

26. INSTRUMENT TYPE	27. SECURITY
RADIOMETER, 13-CHANNEL INFRARED SELECTIVE CHOPPER	UNC

28. APPLICATION	29. SPACECRAFT
MET	NIMBUS E

30. PURPOSE

PRIMARY - TO OBSERVE ATMOSPHERIC TEMPERATURE STRUCTURE UP TO 50 KM IN ALTITUDE *** SECONDARY-TO PROVIDE QUANTITATIVE INFORMATION ABOUT THE DENSITY AND DISTRIBUTION OF CIRRUS CLOUDS AND TROPOSPHERIC WATER VAPOR.

31. PRINCIPLES OF OPERATION

THE INSTRUMENT HAS 13 CHANNELS FROM 8 TO 200 MICRONS. 7 CHANNELS OBSERVE IN THE 15 MICRON CO2 BAND, 2 CHANNELS SOUND THE WATER-VAPOR DISTRIBUTION, AND 4 CHANNELS OBSERVE CIRRUS CLOUDS. THE MAIN CALIBRATION MIRROR REFLECTS RADIATION FROM THE EARTH ONTO TWO VIBRATING MIRRORS WHICH CHOP THIS RADIATION RELATIVE TO SPACE AT 10 HZ. RADIATION FROM THE FIRST MIRROR IS REFLECTED VIA TWO WHITE CELL MIRRORS ONTO TWO DICHROIC BEAM SPLITTERS. THE RADIATION TRANSMITTED BY THESE DICHROIC MIRRORS IS DETECTED AS CHANNELS 9 AND 10, AT 45 AND 133 MICRON CENTER WAVELENGTHS FOR THE DETECTION OF HIGH CIRRUS CLOUDS. THE REFLECTED COMPONENTS FROM THE DICHROIC MIRRORS PASS THROUGH TWO FILTER WHEELS EACH HAVING FOUR FILTERS ONTO TWO THERMISTOR BOLOMETERS,AND ARE DETECTED AS CHANNELS 3 TO 8, 11 AND 12 COVERING 9 TO 18 MICRONS FOR TEMPERATURE SOUNDING AND WATER VAPOR MEASUREMENT. CHANNEL 13 USES A FAST DETECTOR WHICH IS SCANNED BY THE CHOPPER PROVIDING FAIRLY HIGH SPATIAL RESOLUTION. RADIATION FROM THE SECOND VIBRATING MIRROR IS PASSED ALTERNATELY THROUGH A CELL CONTAINING CO2 AND AN EMPTY CELL. THE TWO SIGNALS ARE COMPARED AND THE TEMPERATURE FROM 30-50 KM MAY BE INFERRED. IN-FLIGHT CALIBRATION IS NEEDED TO ESTABLISH BOTH OVERALL GAIN AND ZERO LEVEL.

32. PHENOMENA OBSERVED

RADIATION FROM EARTH, ATMOSPHERE, CLOUDS IN 8-200 MICRON REGION

33. MEASUREMENT RANGE

0 TO 0.35 MILLIBARS OF PRESSURE; 200 TO 250 DEGREES KELVIN

34. PRECISION AND ACCURACY

TEMPERATURE ACCURATE TO WITHIN 1 CENTIGRADE DEGREE

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
8.0 TO 200.0 MICRON		

38. FIELD OF VIEW	39. GROUND SWATH
23. DEG	48 KM DIAM CIRCLE FROM 1100 KM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.6 DEG	10 KM FROM 1100 KM ALTITUDE FOR CHANNEL 13

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
NA	NA	MED	

46. SPECIAL REQUIREMENTS

SINGLE VIEW TO EARTH WITH 23 DEGREE CLEAR CONE ANGLE OF VIEW.

47. COMPONENTS

RADIOMETER WITH ASSOCIATED OPTICS AND ELECTRONICS PACKAGE

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
25 LB	0.31 CU FT	7 WATTS	6 WATTS	15 WATTS	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
NONE	NONE	NONE	SENSITIVE	

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
AT TIMES SELECTED	DELAYED TELEMETRY	

62. TELEMETRY REQUIREMENTS

7 ANALOGUE CHANNELS WITH HALF PERCENT ACCURACY SAMPLED 1 PER SECOND FOR RADIOMETERS; 43 ANALOGUE CHANNELS FOR MONITORING; 33 CHANNELS OF DIGITAL TELEMETRY.

63. ADVANTAGES AND LIMITATIONS

UPPER LEVELS OF ATMOSPHERE CAN BE INVESTIGATED, GOOD RADIOMETRIC ACCURACY, SAME CALIBRATION COMMON TO ALL CHANNELS; MOVING PARTS

64. REFERENCES

1) PROPOSAL FOR SELECTIVE CHOPPER RADIOMETER FOR WATER VAPOR, CLOUD, AND ATMOSPHERIC TEMPERATURE SOUNDING, MAR 68.***2) STATUS REPORT - APPLICATION OF SPACE TECHNOLOGY TO THE WORLD WEATHER WATCH, JUN 67.***3) PROPOSAL FOR A SELECTIVE CHOPPER RADIOMETER ON NIMBUS D, OXFORD AND READING UNIV, APR 66.***4) MEASUREMENTS WITH BALLOON-BORNE SELECTIVE RADIOMETER, CLARENDON LAB, JUN 66.

65. HISTORICAL REMARKS

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
SURFACE-COMPOSITION MAPPING RADIOMETER	SCMR	E23
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
HOVIS, DR. W.A.	GODDARD SPACE FLT CENTER	301-982-6465
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
CALLAHAN, W.R.	FAIRFIELD UNIVERSITY	203-255-1011

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
			01/69		PRELIM DSGN

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B.	NASA HDQTRS	OSSA/SRN	202-962-0891

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
		06/72	33 MONTHS

26. INSTRUMENT TYPE	27. SECURITY
RADIOMETER, TWO-CHANNEL SCANNING INFRARED	UNC

28. APPLICATION	29. SPACECRAFT
ERSP	NIMBUS E

30. PURPOSE

PRIMARY-TO IDENTIFY VARIOUS IGNEOUS ROCK TYPES FROM AN ORBITING SPACECRAFT. TO PRODUCE A THERMAL MAP OF THE SURFACE GIVING SOIL AND SEA SURFACE TEMPERATURES AND ESPECIALLY STRONG SURFACE TEMPERATURE GRADIENTS.***SECONDARY-TO TEST THE APPLICABILITY OF THE RADIOMETER TO MEASURE THE RESTSTRAHLEN (RESIDUAL WAVES) OF ROCKS AND OTHER MATERIALS FROM SPACE.

31. PRINCIPLES OF OPERATION

MEASUREMENT OF THE RESTSTRAHLEN OR RESIDUAL WAVES OF VARIOUS IGNEOUS ROCKS WILL PERMIT ROCK IDENTIFICATION, SINCE THE WAVELENGTH OF THESE WAVES VARIES WITH THE DEGREE OF THE ACIDITY OF THE ROCK. IGNEOUS ROCKS ARE DESCRIBED BY A TERMINOLOGY BASED ON THE SIO2 OR 'ACIDIC' OXIDE CONTENT. THE RESTSTRAHLEN LOWERS THE APPARENT TEMPERATURE, MEASURED RADIOMETRICALLY, BY 12 TO 15 DEGREES C AT CERTAIN WAVELENGTHS. THIS EFFECT CAN BE UTILIZED BY SCANNING SIMULTANEOUSLY IN TWO CHANNELS, 8.3 TO 9.3 AND 10.2 TO 11.2 MICRONS, BOTH AVOIDING THE OZONE BAND. IF ONE CHANNEL RECORDS A LOWER APPARENT RADIANT TEMPERATURE THAN THE OTHER THE DIFFERENCE IS MOST LIKELY DUE TO A DIFFERENCE IN EMISSIVITY. THE PROPOSED RADIOMETER IS AN OUTGROWTH OF THE HRIR AND MRIR FLOWN ON NIMBUS 1 AND 2. THE BASIC COMPONENTS ARE A SCAN MIRROR FOR SPATIAL SCANNING PERPENDICULAR TO SPACECRAFT MOTION, A TELESCOPE TO ENHANCE SPATIAL RESOLUTION, TWO DETECTORS WITH APPROPRIATE FILTERS DEFINING THE WAVELENGTHS INTERVALS DESIRED AND A COOLING DEVICE. THE ROTATING MIRROR IS SPUN AT A RATE SO THAT SUCCESSIVE SCANS ARE CONTIGUOUS. THOUGH THE MIRROR WILL SCAN FROM HORIZON TO HORIZON, DISTORTION AT HIGH ANGLES TO THE LOCAL VERTICAL WILL LIMIT THE USEFUL PORTION OF THE SCAN TO ABOUT 60 DEGREES.

32. PHENOMENA OBSERVED

INFRARED RESTSTRAHLEN (RESIDUAL WAVES) OF SURFACE MATERIALS

33. MEASUREMENT RANGE

DETECTIVITY OF ABOUT 10 TO THE TENTH AT 80 DEGREES KELVIN

34. PRECISION AND ACCURACY

NOISE EQUIVALENT DELTA T =0.17 DEG K AT 280 DEG K AND 10 MICRONS

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
8.3 TO 11.2 MICRONS	33.3 PERCENT	

38. FIELD OF VIEW	39. GROUND SWATH
60. BY 0.03 DEG	800 KM BY 0.6 KM AT 1000 KM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.03 DEG	0.6 BY 0.6 KM AT 1000 KM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED	

46. SPECIAL REQUIREMENTS

INSTRUMENT WILL REQUIRE A CLEAR DEEP SPACE VIEW

47. COMPONENTS

RADIOMETER, TELESCOPE, COOLER

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
55 LB	1.0 CU FT		8 WATTS	15 WATTS	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
NONE	NONE	NONE	SENSITIVE	

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
	SEE ITEM 62	10 MIN/ORBIT MAX

62. TELEMETRY REQUIREMENTS

RADIOMETER WILL REQUIRE 10000 SAMPLES PER SECOND PER CHANNEL FOR MAXIMUM OF 10 MINUTES PER ORBIT. LESS IF RESOLUTION IS DEGRADED. STORAGE VS REAL-TIME TELEMETRY HAS NOT BEEN DEFINED.

63. ADVANTAGES AND LIMITATIONS

DAY AND NIGHT SCANNING, RADIATIVE COOLING, HIGH RESOLUTION, BASED ON HRIR AND MRIR EXPERIENCE; MOVING PARTS.

64. REFERENCES

1) HOVIS, W.A. AND CALLAHAN, W.R.: PROPOSAL FOR A HIGH RESOLUTION SURFACE COMPOSITION MAPPING RADIOMETER FOR NIMBUS E.***2) LYON, R.J.: FIELD INFRARED ANALYSIS OF TERRAIN, 1ST ANNUAL REPT, NASA GRANT NGR-05-020-115.***3) HOVIS, W.A., APPLIED OPTICS, V. 5, 1965.***4) NORDBERG, W., SCIENCE, V. 150, NO. 3696, 1965.

65. HISTORICAL REMARKS

OUTGROWTH OF HRIR AND MRIR FLOWN ON NIMBUS 1 AND 2.

66. DIAGRAMS

TIROS 1

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
VIDICON CAMERA SYSTEM	VCSN	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
NARROW-ANGLE LENS	11/10/69	0003

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
STROUD, W.G. (MGR)	GODDARD SPACE FLT CENTER	301-982-4400
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					POST FLIGHT

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GABBACZ, M.L.	NASA HDQTRS	OSSA/SRO	202-963-4291

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
RCA ASTRO-ELECTRONICS	PRINCETON, NEW JERSEY	04/60	NA

26. INSTRUMENT TYPE	27. SECURITY
IMAGER, NARROW-ANGLE F/1.8 0.5-INCH VIDICON	UNC

28. APPLICATION	29. SPACECRAFT
MET	TIROS 1

30. PURPOSE

PRIMARY-TO ACQUIRE AND TRANSMIT (REALTIME OR DELAYED) PICTURES OF THE EARTHS CLOUD COVER SHOWING SPECIFIC CLOUD TYPES IN GREATER DETAIL THAN WIDE AND MEDIUM ANGLE CAMERAS.

31. PRINCIPLES OF OPERATION

THIS NARROW ANGLE VIDICON CAMERA IS IDENTICAL TO THE ONE THAT WAS FLOWN SUBSEQUENTLY ON TIROS 2. IT CONSISTS OF A 1/2-INCH VIDICON TUBE AND A FOCAL-PLANE SHUTTER THAT PERMITS STORAGE OF STILL PICTURES ON THE TUBE SCREEN. AN ELECTRON BEAM CONVERTS THE STORED PICTURES INTO TELEVISION-TYPE ELECTRONIC SIGNALS, WHICH CAN BE TRANSMITTED TO GROUND RECEIVERS ON COMMAND. THE SYSTEM CAN ALSO PROCESS AND STORE UP TO 32 PICTURES ON MAGNETIC TAPE FOR TRANSMISSION AT A LATER TIME. THE CAMERA HAS A NARROW ANGLE (12 DEGREES) CINEGOR F/1.5 LENS PRODUCING A RESOLUTION OF ABOUT 1000 FEET. THE PHOTOGRAPHS ARE WITHIN THE WIDE-ANGLE CAMERA VIEWS. THE CAMERA HAS A SHUTTER SPEED OF 1.5 MILLISECONDS AND A VIDEO BANDWIDTH OF 62.5 KHZ. THE 500 LINE FRAME IS PROCESSED FOR STORAGE IN 2 SEC. A MINIMUM INTERVAL OF 10 SECONDS BETWEEN PICTURES IS REQUIRED FOR THE TARGET IMAGE TO BE ELECTRICALLY ERASED THE CAMERA IS ALIGNED PARALLEL TO THE SATELLITES SPIN AXIS AND IS AUTOMATICALLY TRIGGERED SO AS TO BE IN A PICTURE TAKING MODE ONLY WHEN DIRECTED TOWARD THE EARTH. TRANSMISSION OF THE ENTIRE REEL OF 32 PICTURES CAN BE ACCOMPLISHED IN 10 SECONDS BY A 2-WATT FM TRANSMITTER OPERATING AT A NOMINAL FREQUENCY OF 235 MHZ.

32. PHENOMENA OBSERVED

CLOUD COVER OVER THE EARTH'S SURFACE

33. MEASUREMENT RANGE

5 LEVELS OF GRAY

34. PRECISION AND ACCURACY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.4 TO 0.65 MICRON		

38. FIELD OF VIEW	39. GROUND SWATH
10.0 BY 10.0 DEG	54 NM BY 54 NM FROM 450 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.02 DEG	850 FT PER TV LINE FROM 450 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED CIRCULAR	MEDIUM POSIGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

TV CAMERA, TRANSMITTER, TAPE RECORDER

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
				9 WATTS	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
	SENSITIVE			MAGNETIC SHIELDING USED

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
NO IN-FLIGHT CALIBRATION	DELAYED OR REALTIME	DAYSIDE OF ORBIT

62. TELEMETRY REQUIREMENTS

FULL REEL OF 32 PICTURES CAN BE READ OUT IN APPROX 100 SECS USING AN FM TRANSMITTER OPERATING AT FREQUENCY OF 235 MHZ.

63. ADVANTAGES AND LIMITATIONS

SHOWED DETAILS OF SPECIFIC CLOUD TYPES.

64. REFERENCES

1) SIGNIFICANT ACHIEVEMENTS IN SAT MET 1958-1964. NASA SP-96.*** 2) GOLDBERG, E.A. AND LANDON, V.D.: KEY EQUIP FOR TIROS 1. ASTRONAUTICS, V.5, JUNE 1960.***3) MESNER, M.H. AND STANISZEWSKI, J.: TV CAMERAS FOR SPACE EXPLOR. ASTRONAUTICS, V.5, MAY 1960.*** 4) INSTRUMENTS AND SPACECRAFT. NASA SP-3028, 1966. ***5) DATA AVAILABLE FROM NATIONAL WEATHER RECORDS CTR (ESSA), ASHEVILLE, NC.

65. HISTORICAL REMARKS

IDENTICAL CAMERA ALSO FLOWN ON TIROS 2

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
VIDICON CAMERA SYSTEM	VCSW	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
WIDE-ANGLE LENS	11/10/69	0003

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
STROUD, W. G. (MGR)	GODDARD SPACE FLT CENTER	301-982-4400
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					POST FLIGHT

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GARBACZ, M.L.	NASA HDQTRS	OSSA/SRO	202-963-4291

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
RCA ASTRO-ELECTRONICS	PRINCETON, NEW JERSEY	04/60	NA

26. INSTRUMENT TYPE	27. SECURITY
IMAGER, WIDE-ANGLE F/1.5 LOW-RESOLUTION 0.5-INCH VIDICON	UNC

28. APPLICATION	29. SPACECRAFT
MET	TIROS 1

30. PURPOSE

PRIMARY-TO ACQUIRE AND TRANSMIT PICTURES OF THE EARTH'S CLOUD COVER TO PROVIDE METEOROLOGISTS WITH DETAILED INFORMATION ON INDIVIDUAL CLOUD TYPES OVER SPECIFIC AREAS.***SECONDARY-TO TEST TV SENSOR IN SPACE.

31. PRINCIPLES OF OPERATION

THIS CAMERA SUB-SYSTEM HAS FLOWN IN AN IDENTICAL CONFIGURATION ON TIROS 1-10 AND SIMILAR CONFIGURATION ON ESSA 1. ON TIROS 1-8, 10 THE CAMERAS WERE ALIGNED PARALLEL TO THE S/C SPIN AXIS AND EXTENDED THROUGH THE BASE PLATE. IT CONSISTS OF A 0.5 IN VIDICON TUBE AND A FOCAL-PLANE SHUTTER THAT PERMITS STORAGE OF STILL PICTURES ON THE TUBE SCREEN. AN ELECTRON BEAM CONVERTS THE STORED PICTURES INTO TELEVISION-TYPE ELECTRONIC SIGNALS WHICH CAN BE TRANSMITTED TO GROUND RECEIVERS ON COMMAND.THE SYSTEM CAN ALSO PROCESS AND STORE UP TO 32 PICTURES ON MAGNETIC TAPE FOR TRANSMISSION AT A LATER TIME. THE CAMERA HAS A WIDE ANGLE (105 DEG) ELGEET F/1.5 LENS PRODUCING A RESOLUTION OF 1.4 TO 2.0 NM. THE CAMERA HAS A SHUTTER SPEED OF 1.5 MILLISEC AND A VIDEO-BAND-WIDTH OF 62.5 KHZ. THE 500 LINE FRAME IS PROCESSED FOR STORAGE IN 2 SEC. A MINIMUM INTERVAL OF 10 SEC BETWEEN PICTURES IS REQUIRED FOR THE TARGET IMAGE TO BE ELECTRICALLY ERASED. THE CAMERA IS ALIGNED PARALLEL TO THE SATELLITES SPIN AXIS AND IS AUTOMATICALLY TRIGGERED SO AS TO BE IN A PICTURE TAKING MODE ONLY WHEN DIRECTED TOWARD THE EARTH. TRANSMISSION OF THE ENTIRE REEL OF 32 PICTURES CAN BE ACCOMPLISHED IN 100 SEC BY A 2-WATT FM TRANSMITTER OPERATING AT A NOMINAL FREQUENCY OF 235 MHZ.

32. PHENOMENA OBSERVED

CLOUD COVER AND THE EARTH'S SURFACE

33. MEASUREMENT RANGE

5 LEVELS OF GRAY

34. PRECISION AND ACCURACY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.4 TO 0.65 MICRON	NA	

38. FIELD OF VIEW	39. GROUND SWATH
74.0 BY 74.0 DEG	650 NM BY 650 NM FROM 450 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.2 DEG	1.4 NM PER TV LINE FROM 450 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED CIRCULAR	MEDIUM POSIGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

TV CAMERA, TRANSMITTER, TAPE RECORDER

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
		9 WATTS		9 WATTS	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
	SENSITIVE			MAGNETIC SHIELDING USED

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
NO IN-FLIGHT CALIBRATION	DELAYED AND REALTIME	DAYSIDE OF ORBIT

62. TELEMETRY REQUIREMENTS

FULL REEL OF 32 PICTURES CAN BE READ OUT IN 100 SECONDS USING DATA FOR WEATHER ANALYSIS THAN FROM MED OR NARROW ANGLE CAMERAS

63. ADVANTAGES AND LIMITATIONS

BROAD SYNOPTIC VIEWING OF CLOUD COVER PATTERNS. MORE VALUABLE DATA FOR WEATHER ANALYSIS THAN FROM MED. OR NARROW ANGLE CAMERAS

64. REFERENCES

1) SIGNIFICANT ACHIEVEMENTS IN SAT MET 1958-1964. NASA SP-96.*** 2) GOLDBERG,E.A. AND LANDON, V.D.:KEY EQUIP FOR TIROS 1. ASTRONAUTICS, V.5, JUNE 1960.***3) MESNER,M.H. AND STANISZEWSKI, J.: TV CAMERAS FOR SPACE EXPLOR. ASTRONAUTICS, V.5, MAY 1960.*** 4) INSTRUMENTS AND SPACECRAFT. NASA SP-3028, 1966. ***5) DATA AVAILABLE FROM NATIONAL WEATHER RECORDS CTR (ESSA),ASHEVILLE,NC.

65. HISTORICAL REMARKS

IDENTICAL CAMERA FLOWN ON TIROS 1-10 AND SIMILAR ON ESSA 1

66. DIAGRAMS

TIROS 2

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
LOW-RESOLUTION NONSCANNING RADIOMETER	LRNR	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0003

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
HANEL, DR. R.	GODDARD SPACE FLT CENTER	301-982-4528
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
STAMPFL, DR. R. A.	GODDARD SPACE FLT CENTER	301-982-6163

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					POST FLIGHT

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GARBACZ, M.L.	NASA HDQTRS	OSSA/SRO	202-963-4291

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
BARNES ENGINEERING CO	STAMFORD, CONN.	11/60	NA

26. INSTRUMENT TYPE	27. SECURITY
RADIOMETER, 2-CHANNEL NON-SCANNING LOW-RESOLUTION INFRARED	UNC

28. APPLICATION	29. SPACECRAFT
MET	TIROS 2

30. PURPOSE

PRIMARY-TO MEASURE THE THERMAL AND REFLECTED SOLAR RADIATION FROM THE EARTH, TO PERMIT THE DETERMINATION OF THE APPARENT BLACKBODY TEMPERATURES AND ALBEDO OF THE EARTH.

31. PRINCIPLES OF OPERATION

THIS LOW-RESOLUTION NON-SCANNING RADIOMETER WAS FLOWN IN AN IDENTICAL CONFIGURATION ON TIROS 2, 3, AND 4. IT CONSISTS OF 2 DETECTORS. ONE OF THESE IS A BLACK THERMISTOR BOLOMETER DETECTOR AND THE OTHER A WHITE ONE, EACH OF WHICH IS MOUNTED IN THE APEX OF A HIGHLY REFLECTIVE CONE. THE BLACK DETECTOR IS EQUALLY SENSITIVE TO REFLECTED SUNLIGHT AND TO LONG WAVE TERRESTRIAL RADIATION (0.2 TO 50 MICRONS). THE WHITE DETECTOR IS COATED TO BE REFLECTIVE IN THE VISIBLE AND NEAR INFRARED, THUS, IT MEASURES ONLY LONG WAVELENGTH THERMAL RADIATION (5 TO 50 MICRONS). THESE DETECTORS PRESENT THE INSTRUMENTATION PACKAGE WITH RESISTANCES WHICH VARY WITH RADIATION. FROM THE DETECTED VALUES THE HEAT BALANCE OF AN AREA CAN BE COMPUTED. THE FIELD WHEN VIEWING DIRECTLY BELOW IS PARALLEL TO THE SPIN AXIS AND IS A CIRCLE OF 470 NM DIAMETER (50-DEGREE FIELD OF VIEW). THIS VIEW OBSERVES AN AREA WHICH IS WITHIN THE FIELD OF THE WIDE ANGLE TELEVISION CAMERA. THE OUTPUT OF EACH DETECTOR IS AMPLIFIED, AND THE RESULTING SIGNAL IS USED TO MODULATE SEPARATE AUDIO-FREQUENCY OSCILLATORS. THIS MODULATED OUTPUT IS PROCESSED THROUGH THE TIME-SHARING SWITCHING CIRCUIT WITH THE OUTPUT OF THE SCANNING RADIOMETER.

32. PHENOMENA OBSERVED

THERMAL AND REFLECTED SOLAR RADIATION FROM EARTH

33. MEASUREMENT RANGE

-100 DEG C TO +60 DEG C

34. PRECISION AND ACCURACY

S/N BETTER THAN 30 DB

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.2 TO 50.0 MICRONS	SEE ITEM 31	

38. FIELD OF VIEW	39. GROUND SWATH
50.0 DEG	470 NM DIAM CIRCLE FROM 410 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
50.0 DEG	470 NM DIAM CIRCLE FROM 410 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED CIRCULAR	MEDIUM POSIGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

2 THERMISTORS, REFERENCE RESISTORS, ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
2 LB		5 WATTS		30 WATTS	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
			SENSITIVE	

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
BY REFERENCE RESISTORS	DELAYED TELEMETRY	CONTINUOUS

62. TELEMETRY REQUIREMENTS

7 FREQUENCY BANDS ARE USED FOR TOTAL IR PACKAGE (LOW + MED IR), THE 7 CHANNELS HAVE A TOTAL WIDTH OF 310 HZ.

63. ADVANTAGES AND LIMITATIONS

STRONG THERMAL COUPLING BETWEEN DETECTOR AND SATELLITE. WHITE DETECTOR COATING AND CONE OPTICS INADEQUATE IN SPECTRAL RESPONSE

64. REFERENCES

1) IR AND REFLECTED SOLAR RADIATION MEASUREMENTS FROM TIROS 2 MET SAT. NASA TN D-1096, NOV. 1961.***2) BANDEEN, W.R.: EXPERIMENTAL APPROACHES TO REMOTE ATMOSPHERIC PROBING IN THE IR FROM SATS. NASA TM X-63188, MAY 1968.***3) BARTKO, F., ET.AL.: TIROS LOW RESOLUTION RADIOMETER. NASA TN D-614, SEPT. 64.***4) DATA AVAILABLE FROM WORLD DATA CENTER, ASHEVILLE, N.C.

65. HISTORICAL REMARKS

IDENTICAL RADIOMETERS FLOWN ON TIROS 2, 3, AND 4

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
MEDIUM-RESOLUTION RADIOMETER	MRR	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
NORDBERG, DR. W.	GODDARD SPACE FLT CENTER	301-982-5003
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					POST FLIGHT

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GARBACZ, M.L.	NASA HDQTRS	OSSA/SRO	202-963-4291

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
BARNES ENGINEERING CO	STAMFORD, CONN.	11/60	NA

26. INSTRUMENT TYPE	27. SECURITY
RADIOMETER, 5-CHAN THERMISTOR-BOLOMETER MED-RES SCANNING IR	UNC

28. APPLICATION	29. SPACECRAFT
MET	TIROS 2

30. PURPOSE

PRIMARY-TO MEASURE EMITTED THERMAL AND REFLECTED SOLAR RADIATION FROM THE EARTH AND ITS ATMOSPHERE IN 5 SPECTRAL REGIONS. PARAMETERS TO BE STUDIED ARE: ATMOSPHERIC WATER VAPOR ABSORPTION BAND, DAY-NIGHT TIME CLOUD COVER, ALBEDO, AND THERMAL RADIATION. TO GENERATE RADIATION MAPS FOR RESEARCH IN ATMOSPHERIC PROPERTIES.

31. PRINCIPLES OF OPERATION

TIROS 2,3,4,7, AND NIMBUS 2 CONTAINED 5 CHANNEL SCANNING RADIOMETERS USING FILTERS AND BOLOMETER DETECTORS. THE NIMBUS 2 RADIOMETER, WHILE SIMILAR IN PURPOSE, WAS A NEW INSTRUMENT DESIGN. ON THE TIROS SERIES PRECISE BANDWIDTHS VARIED FOR EACH FLIGHT, FOR TIROS 2 THEY WERE 5.72-7.0; 7.2-22.2; 0.26-7.6; 7.2-32.6; AND 0.365-3.35 MICRONS. A REFERENCE LEVEL WAS OBTAINED BY HAVING THE DETECTORS ALTERNATELY LOOK INTO SPACE AT A 45 DEGREE ANGLE. EACH CHANNEL HAS THE SAME PRINCIPLE OF OPERATION: THE ALTERNATING VOLTAGE GENERATED AT THE THERMISTOR BOLOMETER IS PROPORTIONAL TO THE DIFFERENCE IN RADIATION ENERGY COMING FROM 2 OPPOSITE DIRECTIONS (THROUGH THE SATELLITE WALL AND BASE) AND IMPINGENT UPON A CHOPPER DISK THAT HAS ALTERNATE BLACK AND MIRRORED HALVES. ALL 5 DISKS ROTATE SIMULTANEOUSLY AT 46 RPS, AND HAVE IDENTICAL OUTPUT CIRCUITRY TO PREAMPLIFIERS AND TAPE RECORDERS. SATELLITE SPIN IS USED TO PROVIDE THE SCAN LINE, WHICH IS THEN ADVANCED BY ORBITAL MOTION OF THE SATELLITE. THE INSTRUMENT HAS A 5 DEG FOV FOR EACH CHANNEL. DATA ARE RECORDED ON THE SATELLITE'S ENDLESS LOOP OF MAGNETIC TAPE FOR A PERIOD OF 100 MIN.

32. PHENOMENA OBSERVED

RADIATION FROM EARTH AND ATMOSPHERE IN 5 SPECTRAL REGIONS

33. MEASUREMENT RANGE

34. PRECISION AND ACCURACY

A S/N RATIO OF BETTER THAN 30 DB; ABSOLUTE ACCURACY OF +-7 DEG K

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.25 TO 32.6 MICRONS	SEE ITEM 31	

38. FIELD OF VIEW	39. GROUND SWATH
5.0 DEG	35 NM DIAM CIRCLE FROM 410 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
5.0 DEG	35 NM AT CENTER FROM 410 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED CIRCULAR	MEDIUM POSIGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

RADIOMETER (5 THERMISTOR BOLOMETER DETECTORS) - ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
6 LB		3 WATTS			

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
			SENSITIVE	

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
SPACE LOOK FOR ZEROING	DELAYED TELEMETRY	CONTINUOUS

62. TELEMETRY REQUIREMENTS

7 FREQUENCY BANDS ARE USED FOR TOTAL IR PACKAGE (LOW + MED IR); THE 7 CHANNELS HAVE A WIDTH OF 310 HZ.

63. ADVANTAGES AND LIMITATIONS

AN UNCERTAINTY EXISTS IN THE ABSOLUTE VALUES OF THE MEASUREMENTS BECAUSE OF NO INFLIGHT CALIBRATION.

64. REFERENCES

1) BANDEEN, W.R. ET.AL.: INFRARED AND REFLECTED SOLAR RADIATION MEASUREMENTS FROM TIROS 2 MET SAT. NASA TN D-1096, NOV. 1961.***
2) DATA CATALOG OF SAT AND ROCKET EXPTS. NASA/GSFC-NATIONAL SPACE SCIENCE DATA CTR. REPT. NSSDC 68-01, JAN. 68. ***3)
GOLDBERG, I.: MET IR INSTRUMENTS FOR SAT. NASA/GSFC, AUG. 68. ***
DATA AVAILABLE FROM NATIONAL SPACE SCIENCE DATA CTR. NASA/GSFC.

65. HISTORICAL REMARKS

SIMILAR RADIOMETERS FLOWN ON TIROS 2,3,4,7 AND NIMBUS 2 (MRIR)

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE		2. ACRONYM	3. EXP NO
VIDICON CAMERA SYSTEM		VCSN	
(TITLE CONT.)		4. RESUME DATE	5. VERSION
NARROW-ANGLE LENS		11/10/69	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
STAMPFL, R. A. (MGR)	GODDARD SPACE FLT CENTER	301-982-6163
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					POST FLIGHT

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GARBACZ, M. L.	NASA HDQTRS	OSSA/SRO	202-963-4291

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
RCA ASTRO-ELECTRONICS	PRINCETON, NEW JERSEY	11/60	NA

26. INSTRUMENT TYPE	27. SECURITY
IMAGER, NARROW-ANGLE F/1.8 0.5-INCH VIDICON	UNC

28. APPLICATION	29. SPACECRAFT
MET	TIROS 2

30. PURPOSE

PRIMARY-TO ACQUIRE AND TRANSMIT(REALTIME OR DELAYED) PICTURES OF THE EARTH'S CLOUD COVER SHOWING SPECIFIC CLOUD TYPES IN GREATER DETAIL THAN WIDE AND MEDIUM ANGLE CAMERAS.

31. PRINCIPLES OF OPERATION

THIS NARROW ANGLE VIDICON CAMERA IS IDENTICAL TO THE ONE THAT WAS FLOWN ON THE FIRST TIROS. IT CONSISTS OF A 1/2-INCH VIDICON TUBE AND A FOCAL-PLANE SHUTTER THAT PERMITS STORAGE OF STILL PICTURES ON THE TUBE SCREEN. AN ELECTRON BEAM CONVERTS THE STORED PICTURES INTO TELEVISION-TYPE ELECTRONIC SIGNALS, WHICH CAN BE TRANSMITTED TO GROUND RECEIVERS ON COMMAND.THE SYSTEM CAN ALSO PROCESS AND STORE UP TO 32 PICTURES ON MAGNETIC TAPE FOR TRANSMISSION AT A LATER TIME. THE CAMERA HAS A NARROW ANGLE (12 DEGREES) CINEGOR F/1.5 LENS PRODUCING A RESOLUTION OF ABOUT 850 FEET. THE PHOTOGRAPHS ARE WITHIN THE FOV OF A COMPANION CAMERA. THE CAMERA HAS A SHUTTER SPEED OF 1.5 MILLISECONDS AND A VIDEO-BANDWIDTH OF 62.5 KHZ. THE 500 LINE FRAME IS PROCESSED FOR STORAGE IN 2 SECS. A MINIMUM INTERVAL OF 10 SECONDS BETWEEN PICTURES IS REQUIRED FOR THE TARGET IMAGE TO BE ELECTRICALLY ERASED. THE CAMERA IS ALIGNED PARALLEL TO THE SATELLITES SPIN AXIS AND IS TURNED ON BY COMMAND. TRANSMISSION OF THE ENTIRE REEL OF 32 PICTURES CAN BE ACCOMPLISHED IN 100 SECONDS BY A 2-WATT FM TRANSMITTER OPERATING AT A NOMINAL FREQUENCY OF 235 MHZ.

32. PHENOMENA OBSERVED

CLOUD COVER OVER THE EARTH'S SURFACE

33. MEASUREMENT RANGE

7 TO 8 LEVELS OF GRAY

34. PRECISION AND ACCURACY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.5 TO 0.65 MICRON		

38. FIELD OF VIEW	39. GROUND SWATH
10.0 BY 10.0 DEG	54 NM BY 54 LM FROM 410 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.02 DEG	850 FEET PER TV-LINE FROM 410 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED CIRCULAR	MEDIUM POSIGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

TV CAMERA, TRANSMITTER, TAPE RECORDER

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
7 LB		9 WATTS	NONE	9 WATTS	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
	SENSITIVE			MAGNETIC SHIELDING USED

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
	DELAYED OR REALTIME	DAYSIDE OF ORBIT

62. TELEMETRY REQUIREMENTS

FULL REEL OF 32 PICTURES CAN BE READ OUT IN APPROX 100 SECS USING AN FM TRANSMITTER OPERATING AT FREQUENCY OF 235 MHZ.

63. ADVANTAGES AND LIMITATIONS

SHOWED DETAILS OF SPECIFIC CLOUD TYPES.

64. REFERENCES

1) SIGNIFICANT ACHIEVEMENTS IN SAT MET 1958-1964. NASA SP-96.*** 2) GOLDBERG, E.A. AND LANDON, V.D.: KEY EQUIP FOR TIROS 1. ASTRONAUTICS, V.5, JUNE 1960.***3) MESNER, M.H. AND STANISZEWSKI, J.: TV CAMERAS FOR SPACE EXPLOR. ASTRONAUTICS, V.5, MAY 1960.*** 4) INSTRUMENTS AND SPACECRAFT. NASA SP-3028, 1966. ***5) DATA AVAILABLE FROM NATIONAL WEATHER RECORDS CTR (ESSA), ASHEVILLE, NC.

65. HISTORICAL REMARKS

IDENTICAL INSTRUMENT FLOWN ON TIROS 1.

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
VIDICON CAMERA SYSTEM	VCSW	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
WIDE-ANGLE LENS	11/10/69	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
STAMPFL, R.A. (MGR)	GODDARD SPACE FLT CENTER	301-982-6163
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					POST FLIGHT

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GARBACZ, M.L.	NASA HDQTRS	OSSA/SRO	202-963-4291

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
RCA ASTRO-ELECTRONICS	PRINCETON, NEW JERSEY	11/60	NA

26. INSTRUMENT TYPE	27. SECURITY
IMAGER, 0.5-INCH WIDE-ANGLE F/1.5 LOW-RESOLUTION VIDICON	UNC

28. APPLICATION	29. SPACECRAFT
MET	TIROS 2

30. PURPOSE

PRIMARY-TO ACQUIRE AND TRANSMIT PICTURES OF THE EARTH'S CLOUD COVER TO PROVIDE METEOROLOGISTS WITH DETAILED INFORMATION ON INDIVIDUAL CLOUD TYPES OVER SPECIFIC AREAS.***SECONDARY-TO TEST TV SENSOR IN SPACE.

31. PRINCIPLES OF OPERATION

THIS CAMERA SUB-SYSTEM HAS FLOWN IDENTICALLY ON TIROS 1 THRU 10. A SIMILAR CONFIGURATION HAS FLOWN ON ESSA 1. ON TIROS 1 THRU 8 & 10 THE CAMERAS WERE ALIGNED PARALLEL TO THE S/C SPIN AXIS AND EXTENDED THROUGH THE BASE PLATE. IT CONSISTS OF A 1/2-IN VIDICON TUBE AND A FOCAL-PLANE SHUTTER THAT PERMITS STORAGE OF STILL PICTURES ON THE TUBE SCREEN. AN ELECTRON BEAM CONVERTS THE STORED PICTURES INTO TELEVISION-TYPE ELECTRONIC SIGNALS, WHICH CAN BE TRANSMITTED TO GROUND RECEIVERS ON COMMAND. THE SYSTEM CAN ALSO PROCESS AND STORE UP TO 32 PICTURES ON MAGNETIC TAPE FOR TRANSMISSION AT A LATER TIME. THE CAMERA HAS A WIDE ANGLE(105 DEG) ELGEET F/1.5 LENS PRODUCING A RESOLUTION OF 1.4 TO 2.0 NM. THE CAMERA HAS A SHUTTER SPEED OF 1.5 MILLISEC AND A VIDEO-BAND-WIDTH OF 62.5 KHZ. THE 500 LINE FRAME IS PROCESSED FOR STORAGE IN 2 SEC. A MINIMUM INTERVAL OF 10 SEC BETWEEN PICTURES IS REQUIRED FOR THE TARGET IMAGE TO BE ELECTRICALLY ERASED. THE CAMERA IS ALIGNED PARALLEL TO THE SPIN AXIS OF THE SATELLITE, AND IS TURNED ON BY COMMAND. TRANSMISSION OF THE ENTIRE REEL OF 32 PICTURES CAN BE ACCOMPLISHED IN 100 SECONDS BY A 2-WATT FM TRANSMITTER OPERATING AT A NOMINAL FREQUENCY OF 235 MHZ.

32. PHENOMENA OBSERVED

CLOUD COVER AND THE EARTH'S SURFACE

33. MEASUREMENT RANGE

7 TO 8 LEVELS OF GRAY

34. PRECISION AND ACCURACY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.5 TO 0.65 MICRON	NA	

38. FIELD OF VIEW	39. GROUND SWATH
74.0 BY 74.0 DEG	650 NM BY 650 NM FROM 410 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.2 DEG	1.4 NM PER TV-LINE FROM 410 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED CIRCULAR	MEDIUM POSIGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

TV CAMERA, TRANSMITTER, TAPE RECORDER

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
7 LB		9 WATTS	NONE	9 WATTS	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
SENSITIVE				MAGNETIC SHIELDING USED

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
	DELAYED AND REALTIME	DAYSIDE OF ORBIT

62. TELEMETRY REQUIREMENTS

FULL REEL OF 32 PICTURES CAN BE READ OUT IN 100 SECONDS USING AN FM TRANSMITTER OPERATING AT FREQUENCY OF 235 MHZ.

63. ADVANTAGES AND LIMITATIONS

BROAD SYNOPTIC VIEWING OF CLOUD COVER PATTERNS. MORE VALUABLE DATA FOR WEATHER ANALYSIS THAN FROM MED OR NARROW ANGLE CAMERAS

64. REFERENCES

1) SIGNIFICANT ACHIEVEMENTS IN SAT MET 1958-1964. NASA SP-96.*** 2) GOLDBERG, E.A. AND LANDON, V.D.: KEY EQUIP FOR TIROS 1. ASTRONAUTICS, V.5, JUNE 1960.***3) MESNER, M.H. AND STANISZEWSKI, J.: TV CAMERAS FOR SPACE EXPLOR. ASTRONAUTICS, V.5, MAY 1960.*** 4) INSTRUMENTS AND SPACECRAFT. NASA SP-3028, 1966. ***5) DATA AVAILABLE FROM NATIONAL WEATHER RECORDS CTR (ESSA), ASHEVILLE, NC.

65. HISTORICAL REMARKS

IDENTICAL CAMERA FLOWN ON TIROS 1-10; SIMILAR CAMERA ON ESSA 1.

66. DIAGRAMS

TIROS 3

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
LOW-RESOLUTION NONSCANNING RADIOMETER	LRNR	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
HANEL, DR. R.	GODDARD SPACE FLT CENTER	301-982-4528
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
STAMPFL, DR. R. A.	GODDARD SPACE FLT CENTER	301-982-6163

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					POST FLIGHT

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GARBACZ, M.L.	NASA HDQTRS	OSSA/SRO	202-963-4291

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
BARNES ENGINEERING CO	STAMFORD, CONN.	07/61	NA

26. INSTRUMENT TYPE	27. SECURITY
RADIOMETER, 2-CHANNEL NON-SCANNING LOW-RESOLUTION INFRARED	UNC

28. APPLICATION	29. SPACECRAFT
MET	TIROS 3

30. PURPOSE

PRIMARY-TO MEASURE THE THERMAL AND REFLECTED SOLAR RADIATION FROM THE EARTH, TO PERMIT THE DETERMINATION OF THE APPARENT BLACKBODY TEMPERATURES AND ALBEDO OF THE EARTH.

31. PRINCIPLES OF OPERATION

THIS LOW-RESOLUTION NON-SCANNING RADIOMETER WAS FLOWN IN AN IDENTICAL CONFIGURATION ON TIROS 2, 3, AND 4. IT CONSISTS OF 2 DETECTORS. ONE OF THESE IS A BLACK THERMISTOR BOLOMETER DETECTOR AND THE OTHER A WHITE ONE, EACH OF WHICH IS MOUNTED IN THE APEX OF A HIGHLY REFLECTIVE CONE. THE BLACK DETECTOR IS EQUALLY SENSITIVE TO REFLECTED SUNLIGHT AND TO LONG WAVE TERRESTRIAL RADIATION(0.2 TO 50 MICRONS). THE WHITE DETECTOR IS COATED TO BE REFLECTIVE IN THE VISIBLE AND NEAR INFRARED, THUS,IT MEASURES ONLY LONG WAVELENGTH THERMAL RADIATION(5 TO 50 MICRONS). THESE DETECTORS PRESENT THE INSTRUMENTATION PACKAGE WITH RESISTANCES WHICH VARY WITH RADIATION. FROM THE DETECTED VALUES THE HEAT BALANCE OF AN AREA CAN BE COMPUTED. THE FIELD WHEN VIEWING DIRECTLY BELOW IS PARALLEL TO THE SPIN AXIS AND IS A CIRCLE OF 470 NM DIAMETER(50-DEGREE FIELD OF VIEW). THIS VIEW OBSERVES AN AREA WHICH IS WITHIN THE FIELD OF THE WIDE ANGLE TELEVISION CAMERA. THE OUTPUT OF EACH DETECTOR IS AMPLIFIED, AND THE RESULTING SIGNAL IS USED TO MODULATE SEPARATE AUDIO-FREQUENCY OSCILLATORS. THIS MODULATED OUTPUT IS PROCESSED THROUGH THE TIME-SHARING SWITCHING CIRCUIT WITH THE OUTPUT OF THE SCANNING RADIOMETER.

32. PHENOMENA OBSERVED

THERMAL AND REFLECTED SOLAR RADIATION FROM THE EARTH

33. MEASUREMENT RANGE

-100 DEG C TO +60 DEG C

34. PRECISION AND ACCURACY

S/N BETTER THAN 30 DB

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.2 TO 50.0 MICRONS	SEE ITEM 31	

38. FIELD OF VIEW	39. GROUND SWATH
50.0 DEG	470 NM DIAM CIRCLE FROM 475 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
50.0 DEG	470 NM FROM 475 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED CIRCULAR	MEDIUM POSIGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

2 THERMISTORS, REFERENCE RESISTORS, ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
2 LB		5 WATTS		30 WATTS	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
				SENSITIVE

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
BY REFERENCE RESISTORS	DELAYED TELEMETRY	CONTINUOUS

62. TELEMETRY REQUIREMENTS

7 FREQUENCY BANDS ARE USED FOR TOTAL IR PACKAGE (LOW + MED IR), THE 7 CHANNELS HAVE A TOTAL WIDTH OF 310 HZ.

63. ADVANTAGES AND LIMITATIONS

STRONG THERMAL COUPLING BETWEEN DETECTOR AND SATELLITE. WHITE DETECTOR COATING AND CONE OPTICS INADEQUATE IN SPECTRAL RESPONSE

64. REFERENCES

1) IR AND REFLECTED SOLAR RADIATION MEASUREMENTS FROM TIROS 2 MET SAT. NASA TN D-1096, NOV. 1961.***2) BANDEEN, W.R.: EXPERIMENTAL APPROACHES TO REMOTE ATMOSPHERIC PROBING IN THE IR FROM SATS. NASA TM X-63188, MAY 1968.***3) BARTKO, F., ET.AL.: TIROS LOW RESOLUTION RADIOMETER. NASA TN D-614, SEPT. 64.***4) DATA AVAILABLE FROM WORLD DATA CENTER, ASHEVILLE, N.C.

65. HISTORICAL REMARKS

IDENTICAL INSTRUMENT FLOWN ON TIROS 2, 3, AND 4.

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
LOW-RESOLUTION OMNIDIRECTIONAL RADIOMETER	LROR	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
SUOMI, DR. V.E.	UNIVERSITY OF WISCONSIN	608-262-5938
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
PARENT, DR. R. J.	UNIVERSITY OF WISCONSIN	608-262-5938

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					POST FLIGHT

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GARBACZ, M.L.	NASA HDQTRS	OSSA/SRO	201-963-4291

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
UNIVERSITY OF WISCONSIN	MADISON, WISCONSIN	07/61	NA

26. INSTRUMENT TYPE	27. SECURITY
RADIOMETER, IR OMNIDIRECTIONAL NON-SCANNING LOW-RESOLUTION	UNC

28. APPLICATION	29. SPACECRAFT
MET	TIROS 3

30. PURPOSE

PRIMARY- TO MEASURE THE GROSS HEAT BUDGET OF THE EARTH.*** SECONDARY-TO DETERMINE HOW MUCH SOLAR ENERGY IS ABSORBED, REFLECTED, AND EMITTED BY THE EARTH AND ITS ATMOSPHERE AT THE UPPER BOUNDARY; THUS TO STUDY THE PRIME DRIVING FORCE OF THE CIRCULATION OF THE ATMOSPHERE.

31. PRINCIPLES OF OPERATION

THIS EXPERIMENT WAS FLOWN IN AN IDENTICAL CONFIGURATION ON TIROS 3, 4, AND 7, AND WAS ALSO SIMILAR TO ONE ON EXPLORER 7. TWO WIDE ANGLE (180 DEG FOV) LOW-RESOLUTION IR DETECTION DEVICES, EACH COMPOSED OF A BLACK-AND-WHITE BOLOMETER AND A REFLECTING MIRROR, ARE MOUNTED 180-DEGREES APART ON TELESCOPING SUPPORTS WHICH PROJECT FROM THE SIDE OF THE SPACECRAFT. THE MIRRORS SHIELD EACH SENSOR FROM DIRECT RADIATION EMITTED BY THE SATELLITE'S BODY. BOTH BOLOMETERS HAVE A HIGH ABSORPTIVITY TO THE IR RADIATION FROM THE EARTH. THE BLACK BOLOMETER ALSO HAS A HIGH ABSORPTIVITY FOR SOLAR RADIATION. THUS REFLECTED AND EMITTED RADIATION CAN BE SEPARATED. THERMISTORS, FASTENED INSIDE OF THE HEMISPHERIC SHELLS, MEASURE SENSOR TEMPERATURES. MATCHED PAIRS OF THERMISTORS ARE CONNECTED IN SERIES WITH SIMILAR SENSORS ON OPPOSITE SIDES OF THE SPACECRAFT; THEREFORE, THE MEASURED SENSOR TEMPERATURE RECEIVED FROM THE SATELLITE IS AN AVERAGE OF TWO TEMPERATURES FROM MATCHED THERMISTORS AND SIMULATES THE RESPONSE OF AN ISOLATED SPHERE IN SPACE. THE INFORMATION TELEMETERED TO EARTH INCLUDES TEMPERATURES OF THE MIRRORS AND SENSORS AND A FIXED RESISTANCE VALUE WHICH ALLOWS ONE TO COMPENSATE FOR DRIFT OF THE ELECTRONICS IN THE SATELLITE.

32. PHENOMENA OBSERVED

RADIANT ENERGY REFLECTED AND EMMITTED BY THE EARTH.

33. MEASUREMENT RANGE

128 DEG K TO 488 DEG K

34. PRECISION AND ACCURACY

0.1 KELVIN DEGREE

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.3 TO 60.0 MICRON	NA	5. SECONDS

38. FIELD OF VIEW	39. GROUND SWATH
180.0 DEG	500 NM RADIUS CIRCLE FROM 475 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
NA	NA

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
NA	NA	MED CIRCULAR	MEDIUM POSIGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

2 DETECTION DEVICES, ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
3 LB		1 WATT			

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
				SENSITIVE MIRRORS SHIELD SENSORS

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
	DELAYED TELEMETRY	CONTINUOUS

62. TELEMETRY REQUIREMENTS

DATA FROM THIS AND OTHER IR EXPTS ON-BOARD ARE RECORDED CONTINUOUSLY FOR ONE ORBIT ON MAGNETIC TAPE FOR PLAYBACK ON COMMAND FROM ONE OF THE GROUND STATIONS.

63. ADVANTAGES AND LIMITATIONS

64. REFERENCES

1) HOUSE, F.B., RADIATION BALANCE OF THE EARTH FROM A SATELLITE, PHD THESIS, U. OF WISC. 1965.***2) VONDERHAAR, T.H., VARIATIONS OF THE EARTH'S RADIATION BUDGET, PHD THESIS, U. OF WISC. 1968.*** 3) MISSION PLAN TIROS 7, GSFC RPT NO. X-650-63-99, MAY 1963.*** 4) DATA AVAILABLE FROM NATIONAL SPACE SCIENCE DATA CENTER, NASA/GSFC.

65. HISTORICAL REMARKS

IDENTICAL INSTRUMENT FLOWN ON TIROS 3, 4, AND 7; SIMILAR ON EXP 7

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
MEDIUM-RESOLUTION RADIOMETER	MRR	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
NORDBERG, DR. W.	GODDARD SPACE FLT CENTER	301-982-5003
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					POST FLIGHT

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GARBACZ, M.L.	NASA HDQTRS	OSSA/SRO	202-963-4291

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
BARNES ENGINEERING CO	STAMFORD, CONN.	11/60	NA

26. INSTRUMENT TYPE	27. SECURITY
RADIOMETER, 5-CHANNEL THERMISTOR-BOLOMETER MED-RES SCANNING	UNC

28. APPLICATION	29. SPACECRAFT
MET	TIROS 3

30. PURPOSE

PRIMARY-TO MEASURE EMITTED THERMAL AND REFLECTED SOLAR RADIATION FROM THE EARTH AND ITS ATMOSPHERE IN 5 SPECTRAL REGIONS. PARAMETERS TO BE STUDIED ARE: ATMOSPHERIC WATER VAPOR ABSORPTION BAND, DAY-NIGHT TIME CLOUD COVER, ALBEDO, AND THERMAL RADIATION. TO GENERATE RADIATION MAPS FOR RESEARCH IN ATMOSPHERIC PROPERTIES.

31. PRINCIPLES OF OPERATION

TIROS 2,3,4,7, AND NIMBUS 2 CONTAINED 5-CHANNEL SCANNING RADIOMETERS USING FILTERS AND BOLOMETER DETECTORS. THE NIMBUS 2 RADIOMETER, WHILE SIMILAR IN PURPOSE, WAS A NEW INSTRUMENT DESIGN. ON THE TIROS SERIES PRECISE BANDWIDTHS VARIED FOR EACH FLIGHT, FOR TIROS 3 THEY WERE: 5.7-7.0; 7.07-25.0; 0.25-6.82; 7.4-32.6; AND 0.475-2.900 MICRONS. A REFERENCE LEVEL WAS OBTAINED BY HAVING THE DETECTORS ALTERNATELY LOOK INTO SPACE AT A 45 DEGREE ANGLE. EACH CHANNEL HAS THE SAME PRINCIPLE OF OPERATION: THE ALTERNATING VOLTAGE GENERATED AT THE THERMISTOR BOLOMETER IS PROPORTIONAL TO THE DIFFERENCE IN RADIATION ENERGY COMING FROM 2 OPPOSITE DIRECTIONS (THROUGH THE SATELLITE WALL AND BASE) AND IMPINGENT UPON A CHOPPER DISK THAT HAS ALTERNATE BLACK AND MIRRORED HALVES. ALL 5 DISKS ROTATE SIMULTANEOUSLY AT 46 RPS, AND HAVE IDENTICAL OUTPUT CIRCUITRY TO PREAMPLIFIERS AND TAPE RECORDERS. SATELLITE SPIN IS USED TO PROVIDE THE SCAN LINE, WHICH IS THEN ADVANCED BY ORBITAL MOTION OF THE SATELLITE. THE INSTRUMENT HAS A 5 DEG FOV FOR EACH CHANNEL. DATA ARE RECORDED ON THE SATELLITE'S ENDLESS LOOP OF MAGNETIC TAPE FOR A PERIOD OF 100 MIN.

32. PHENOMENA OBSERVED

RADIATION FROM EARTH AND ATMOSPHERE IN 5 SPECTRAL REGIONS

33. MEASUREMENT RANGE

34. PRECISION AND ACCURACY

A S/N RATIO OF BETTER THAN 30 DB; ABSOLUTE ACCURACY OF +-7 DEG K

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.2 TO 32.6 MICRONS	SEE ITEM 31	

38. FIELD OF VIEW	39. GROUND SWATH
5.0 DEG	40 NM DIAM CIRCLE FROM 475 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
5.0 DEG	40 NM AT CENTER FROM 475 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED CIRCULAR	MEDIUM POSIGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

RADIOMETER (5 THERMISTOR BOLOMETER DETECTORS) - ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
6 LB		3 WATTS			

54. AF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
			SENSITIVE	

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
SPACE LOOK FOR ZEROING	DELAYED TELEMETRY	CONTINUOUS

62. TELEMETRY REQUIREMENTS

7 FREQUENCY BANDS ARE USED FOR TOTAL IR PACKAGE (LOW + MED IR); THE 7 CHANNELS HAVE A WIDTH OF 310 HZ.

63. ADVANTAGES AND LIMITATIONS

AN UNCERTAINTY EXISTS IN THE ABSOLUTE VALUES OF THE MEASUREMENTS BECAUSE OF NO INFLIGHT CALIBRATION.

64. REFERENCES

1) TIROS 4 RADIATION DATA CATALOG AND USER'S MANUAL GSFC, DEC 63. ***2) DATA CATALOG OF SATELLITE AND ROCKET EXPTS. NSSDC 68-01, JAN 68. NASA/GSFC NATIONAL SPACE SCIENCE DATA CTR. ***3) GOLDBERG, I.: METEOROLOGICAL INFRARED INSTRUMENTS FOR SATELLITES. NASA/GSFC, AUG. 1968. ***4) DATA AVAILABLE FROM NATIONAL SPACE SCIENCE DATA CENTER, NASA/GSFC.

65. HISTORICAL REMARKS

SIMILAR RADIOMETERS FLOWN ON TIROS 2,3,4,7 AND NIMBUS 2 (MRIR)

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
VIDICON CAMERA SYSTEM	VCSW	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
WIDE-ANGLE LENS	11/10/69	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
RADOS, R. M. (MGR.)	GODDARD SPACE FLT CENTER	301-982-5347
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					POST FLIGHT

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GARBACZ, M.L.	NASA HDQTRS	OSSA/SRO	202-963-4291

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
RCA ASTRO-ELECTRONICS	PRINCETON, NEW JERSEY	07/61	NA

26. INSTRUMENT TYPE	27. SECURITY
IMAGER, 0.5-INCH WIDE-ANGLE F/1.5 LOW RESOLUTION VIDICON	UNC

28. APPLICATION	29. SPACECRAFT
MET	TIROS 3

30. PURPOSE

PRIMARY-TO ACQUIRE AND TRANSMIT PICTURES OF THE EARTH'S CLOUD COVER TO PROVIDE METEOROLOGISTS WITH DETAILED INFORMATION ON INDIVIDUAL CLOUD TYPES OVER SPECIFIC AREAS.***SECONDARY-TO TEST TV SENSOR IN SPACE.

31. PRINCIPLES OF OPERATION

THIS CAMERA SUB-SYSTEM HAS FLOWN IN AN IDENTICAL CONFIGURATION ON TIROS 1-10 AND SIMILAR CONFIGURATION ON ESSA 1, HOWEVER ON THIS FLIGHT(TIROS 3) 2 WIDE ANGLE CAMERAS WERE USED. IT CONSISTS OF A 1/2 IN VIDICON TUBE AND A FOCAL-PLANE SHUTTER THAT PERMITS STORAGE OF STILL PICTURES ON THE TUBE SCREEN. AN ELECTRON BEAM CONVERTS THE STORED PICTURES INTO TELEVISION-TYPE ELECTRONIC SIGNALS,WHICH CAN BE TRANSMITTED TO GROUND RECEIVERS ON COMMAND. THE SYSTEM CAN ALSO PROCESS AND STORE UP TO 32 PICTURES ON MAGNETIC TAPE FOR TRANSMISSION AT A LATER TIME. THE CAMERA HAS A WIDE ANGLE(105 DEG) ELGEET F/1.5 LENS PRODUCING A RESOLUTION OF 1.5 TO 2.0 NM. THE CAMERA HAS A SHUTTER SPEED OF 1.5 MILLISEC AND A VIDEO-BANDWIDTH OF 62.5 KHZ. THE 500 LINE FRAME IS PROCESSED FOR STORAGE IN 2 SEC. A MINIMUM INTERVAL OF 10 SEC BETWEEN PICTURES IS REQUIRED FOR THE TARGET IMAGE TO BE ELECTRICALLY ERASED. THE CAMERA IS ALIGNED PARALLEL TO THE SATELLITE'S SPIN AXIS AND IS AUTOMATICALLY TRIGGERED SO AS TO BE IN A PICTURE TAKING MODE ONLY WHEN DIRECTED TOWARD THE EARTH. TRANSMISSION OF THE ENTIRE REEL OF 32 PICTURES CAN BE ACCOMPLISHED IN 100 SEC BY A 2-WATT FM TRANSMITTER OPERATING AT NOMINAL FREQUENCY OF 235 MHZ.

32. PHENOMENA OBSERVED

CLOUD COVER AND THE EARTH'S SURFACE

33. MEASUREMENT RANGE

7 TO 8 LEVELS OF GRAY

34. PRECISION AND ACCURACY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.5 TO 0.65 MICRONS	NA	

38. FIELD OF VIEW	39. GROUND SWATH
74.0 BY 74.0 DEG	750 NM 750 NM FROM 475 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.2 DEG	1.5 NM PER TV-LINE FROM 475 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED CIRCULAR	MEDIUM POSIGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

TV CAMERA, TRANSMITTER, TAPE RECORDER

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
7 LB		9 WATTS	NONE	9 WATTS	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
	SENSITIVE			MAGNETIC SHIELDING USED

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
NO IN-FLIGHT CALIBRATION	DELAYED AND REALTIME	DAYSIDE OF ORBIT

62. TELEMETRY REQUIREMENTS

FULL REEL OF 32 PICTURES CAN BE READ OUT IN 100 SECONDS USING AN FM TRANSMITTER OPERATING AT FREQUENCY OF 235 MHZ.

63. ADVANTAGES AND LIMITATIONS

BROAD SYNOPTIC VIEWING OF CLOUD COVER PATTERNS. MORE VALUABLE DATA FOR WEATHER ANALYSIS THAN FROM MED OR NARROW ANGLE CAMERAS

64. REFERENCES

1) SIGNIFICANT ACHIEVEMENTS IN SAT MET 1958-1964. NASA SP-96.*** 2) GOLDBERG, E.A. AND LANDON, V.D.: KEY EQUIP FOR TIROS 1. ASTRONAUTICS, V.5, JUNE 1960.***3) MESNER, M.H. AND STANISZEWSKI, J.: TV CAMERAS FOR SPACE EXPLOR. ASTRONAUTICS, V.5, MAY 1960.*** 4) INSTRUMENTS AND SPACECRAFT. NASA SP-3028, 1966. ***5) DATA AVAILABLE FROM NATIONAL WEATHER RECORDS CTR (ESSA),ASHEVILLE,NC.

65. HISTORICAL REMARKS

IDENTICAL CAMERA FLOWN ON TIROS 1-10; SIMILAR CAMERA ON ESSA 1

66. DIAGRAMS

TIROS 4

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
LOW-RESOLUTION NONSCANNING RADIOMETER	LRNR	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0003

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
HANEL, DR. R.	GODDARD SPACE FLT CENTER	301-982-4528
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
STAMPFL, DR. R.A.	GODDARD SPACE FLT CENTER	301-982-6163

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					POST FLIGHT

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GARBACZ, M.L.	NASA HDQTRS	OSSA/SRO	202-962-4291

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
BARNES ENGINEERING CO	STAMFORD, CONN.	02/62	NA

26. INSTRUMENT TYPE	27. SECURITY
RADIOMETER, 2-CHANNEL NON-SCANNING LOW-RESOLUTION INFRARED	UNC

28. APPLICATION	29. SPACECRAFT
MET	TIROS 4

30. PURPOSE

PRIMARY-TO MEASURE THE THERMAL AND REFLECTED SOLAR RADIATION FROM THE EARTH, TO PERMIT THE DETERMINATION OF THE APPARENT BLACKBODY TEMPERATURES AND ALBEDO OF THE EARTH.

31. PRINCIPLES OF OPERATION

THIS LOW-RESOLUTION NON-SCANNING RADIOMETER WAS FLOWN IN AN IDENTICAL CONFIGURATION ON TIROS 2, 3, AND 4. IT CONSISTS OF 2 DETECTORS. ONE OF THESE IS A BLACK THERMISTOR BOLOMETER DETECTOR AND THE OTHER A WHITE ONE, EACH OF WHICH IS MOUNTED IN THE APEX OF A HIGHLY REFLECTIVE CONE. THE BLACK DETECTOR IS EQUALLY SENSITIVE TO REFLECTED SUNLIGHT AND TO LONG WAVE TERRESTRIAL RADIATION (0.2 TO 50 MICRONS). THE WHITE DETECTOR IS COATED TO BE REFLECTIVE IN THE VISIBLE AND NEAR INFRARED, THUS, IT MEASURES ONLY LONG WAVELENGTH THERMAL RADIATION (5 TO 50 MICRONS). THESE DETECTORS PRESENT THE INSTRUMENTATION PACKAGE WITH RESISTANCES WHICH VARY WITH RADIATION. FROM THE DETECTED VALUES THE HEAT BALANCE OF AN AREA CAN BE COMPUTED. THE FIELD WHEN VIEWING DIRECTLY BELOW IS PARALLEL TO THE SPIN AXIX AND IS A CIRCLE OF 470 NM DIAMETER (50-DEGREE FIELD OF VIEW). THIS VIEW OBSERVES AN AREA WHICH IS WITHIN THE FIELD OF THE WIDE ANGLE TELEVISION CAMERA. THE OUTPUT OF EACH DETECTOR IS AMPLIFIED, AND THE RESULTING SIGNAL IS USED TO MODULATE SEPARATE AUDIO-FREQUENCY OSCILLATORS. THIS MODULATED OUTPUT IS PROCESSED THROUGH THE TIME-SHARING SWITCHING CIRCUIT WITH THE OUTPUT OF THE SCANNING RADIOMETER.

32. PHENOMENA OBSERVED

THERMAL AND REFLECTED SOLAR RADIATION FROM THE EARTH

33. MEASUREMENT RANGE

-100 DEG C TO +60 DEG C

34. PRECISION AND ACCURACY

S/N BETTER THAN 30 DB

35. SPECTRAL RANGE			36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.2	TO	50.0 MICRONS	SEE ITEM 31	

38. FIELD OF VIEW	39. GROUND SWATH
50.0 DEG	480 NM DIAM CIRCLE FROM 450 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
50.0 DEG	480 NM AT CENTER FROM 450 NM ALT

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED CIRCULAR	MEDIUM POSIGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

2 THERMISTORS, REFERENCE RESISTORS, ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
2 LB		5 WATTS		30 WATTS	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
			SENSITIVE	

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
BY REFERENCE RESISTORS	DELAYED TELEMETRY	CONTINUOUS

62. TELEMETRY REQUIREMENTS

7 FREQUENCY BANDS ARE USED FOR TOTAL IR PACKAGE (LOW + MED IR), THE 7 CHANNELS HAVE A TOTAL WIDTH OF 310 HZ.

63. ADVANTAGES AND LIMITATIONS

STRONG THERMAL COUPLING BETWEEN DETECTOR AND SATELLITE. WHITE DETECTOR COATING AND CONE OPTICS INADEQUATE IN SPECTRAL RESPONSE

64. REFERENCES

1) IR AND REFLECTED SOLAR RADIATION MEASUREMENTS FROM TIROS 2 METSAT. NASA TN D-1096, NOV. 1961.***2) BANDEEN, W.R.: EXPERIMENTAL APPROACHES TO REMOTE ATMOSPHERIC PROBING IN THE IR FROM SATS. NASA TM X-63188, MAY 1968.***3) BARTKO, F., ET.AL.: TIROS LOW RESOLUTION RADIOMETER. NASA TN D-614, SEPT. 64.***4) DATA AVAILABLE FROM WORLD DATA CENTER, ASHEVILLE, N.C.

65. HISTORICAL REMARKS

IDENTICAL INSTRUMENT FLOWN ON TIROS 2, 3, AND 4

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
LOW-RESOLUTION OMNIDIRECTIONAL RADIOMETER	LROR	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
SUOMI, DR. V. E.	UNIVERSITY OF WISCONSIN	608-262-5938
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
PARENT, DR. R. J.	UNIVERSITY OF WISCONSIN	608-262-5938

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					POST FLIGHT

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GARBACZ, M.L.	NASA HDQTRS	OSSA/SRO	202-962-4291

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
UNIVERSITY OF WISCONSIN	MADISON, WISCONSIN	02/62	NA

26. INSTRUMENT TYPE	27. SECURITY
RADIOMETER, IR OMNIDIRECTIONAL NON-SCANNING LOW-RESOLUTION	UNC

28. APPLICATION	29. SPACECRAFT
MET	TIROS 4

30. PURPOSE

PRIMARY- TO MEASURE THE GROSS HEAT BUDGET OF THE EARTH.*** SECONDARY-TO DETERMINE HOW MUCH SOLAR ENERGY IS ABSORBED, REFLECTED, AND EMITTED BY THE EARTH AND ITS ATMOSPHERE AT THE UPPER BOUNDARY; THUS TO STUDY THE PRIME DRIVING FORCE OF THE CIRCULATION OF THE ATMOSPHERE.

31. PRINCIPLES OF OPERATION

THIS EXPERIMENT WAS FLOWN IN AN IDENTICAL CONFIGURATION ON TIROS 3, 4, AND 7, AND WAS ALSO SIMILAR TO ONE ON EXPLORER 7. TWO WIDE ANGLE (180 DEG FOV) LOW-RESOLUTION IR DETECTION DEVICES, EACH COMPOSED OF A BLACK-AND-WHITE BOLOMETER AND A REFLECTING MIRROR, ARE MOUNTED 180-DEGREES APART ON TELESCOPING SUPPORTS WHICH PROJECT FROM THE SIDE OF THE SPACECRAFT. THE MIRRORS SHIELD EACH SENSOR FROM DIRECT RADIATION EMITTED BY THE SATELLITE'S BODY. BOTH BOLOMETERS HAVE A HIGH ABSORPTIVITY TO THE IR RADIATION FROM THE EARTH. THE BLACK BOLOMETER ALSO HAS A HIGH ABSORPTIVITY FOR SOLAR RADIATION. THUS REFLECTED AND EMITTED RADIATION IS MEASURED. THE SENSOR TEMPERATURES ARE MEASURED BY THERMISTORS FASTENED TO THE INSIDE OF THE HEMISPHERIC SHELLS. MATCHED PAIRS OF THERMISTORS ARE CONNECTED IN SERIES WITH SIMILAR SENSORS ON OPPOSITE SIDES OF THE SPACECRAFT. THEREFORE, THE MEASURED SENSOR TEMPERATURE RECEIVED FROM THE SATELLITE IS AN AVERAGE OF TWO TEMPERATURES FROM MATCHED THERMISTORS AND SIMULATES THE RESPONSE OF AN ISOLATED SPHERE IN SPACE. THE INFORMATION TELEMETERED TO EARTH INCLUDES TEMPERATURES OF THE MIRRORS AND SENSORS AND A FIXED RESISTANCE VALUE WHICH ALLOWS ONE TO COMPENSATE FOR DRIFT OF THE ELECTRONICS IN THE SATELLITE.

32. PHENOMENA OBSERVED

RADIANT ENERGY REFLECTED AND EMMITTED BY THE EARTH.

33. MEASUREMENT RANGE

128 DEG K TO 488 DEG K

34. PRECISION AND ACCURACY

0.1 KELVIN DEGREE

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.3 TO 60.0 MICRON	NA	5. SECONDS

38. FIELD OF VIEW	39. GROUND SWATH
180.0 DEG	470 NM RADIUS CIRCLE FROM 450 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
NA	

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
NA	NA	MED CIRCULAR	MEDIUM POSIGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

2 DETECTION DEVICES, ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
3 LB		1 WATT			

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
			SENSITIVE	MIRRORS SHIELD SENSORS

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
	DELAYED TELEMETRY	CONTINUOUS

62. TELEMETRY REQUIREMENTS

DATA FROM THIS AND OTHER IR EXPTS ON-BOARD ARE RECORDED CONTINUOUSLY FOR ONE ORBIT ON MAGNETIC TAPE FOR PLAYBACK ON COMMAND FROM ONE OF THE GROUND STATIONS.

63. ADVANTAGES AND LIMITATIONS

64. REFERENCES

1) HOUSE, F.B., RADIATION BALANCE OF THE EARTH FROM A SATELLITE, PHD THESIS, U. OF WISC. 1965.***2) VONDERHAAR, T.H., VARIATIONS OF THE EARTH'S RADIATION BUDGET, PHD THESIS, U. OF WISC. 1968.*** 3) MISSION PLAN TIROS 7, GSFC RPT NO. X-650-63-99, MAY 1963.*** 4) DATA AVAILABLE FROM NATIONAL SPACE SCIENCE DATA CENTER, NASA/GSFC.

65. HISTORICAL REMARKS

FIRST MEASUREMENTS FROM S/C OF EARTH'S TOTAL RADIATION BUDGET.

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
MEDIUM-RESOLUTION RADIOMETER	MRR	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
NORDBERG, DR. W.	GODDARD SPACE FLT CENTER	301-982-5003
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					POST FLIGHT

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GARBACZ, M.L.	NASA HDQTRS	OSSA/SRO	202-962-4291

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
BARNES ENGINEERING CO	STAMFORD, CONN.	11/60	NA

26. INSTRUMENT TYPE	27. SECURITY
RADIOMETER, 5-CHANNEL THERMISTOR-BOLOMETER MED-RES SCANNING	UNC

28. APPLICATION	29. SPACECRAFT
MET	TIROS 4

30. PURPOSE

PRIMARY-TO MEASURE EMITTED THERMAL AND REFLECTED SOLAR RADIATION FROM THE EARTH AND ITS ATMOSPHERE IN 5 SPECTRAL REGIONS. PARAMETERS TO BE STUDIED ARE:ATMOSPHERIC WATER VAPOR ABSORPTION BAND, DAY-NIGHTTIME CLOUD COVER, ALBEDO, AND THERMAL RADIATION.
TO GENERATE RADIATION MAPS FOR RESEARCH IN ATMOSPHERIC PROPERTIES.

31. PRINCIPLES OF OPERATION

TIROS 2,3,4,7, AND NIMBUS 2 CONTAINED 5 CHANNEL SCANNING RADIOMETERS USING FILTERS AND BOLOMETER DETECTORS. THE NIMBUS 2 RADIOMETER, WHILE SIMILAR IN PURPOSE, WAS A NEW INSTRUMENT DESIGN.ON THE TIROS SERIES PRECISE BANDWIDTHS VARIED FOR EACH FLIGHT, FOR TIROS 4 THEY WERE:6.0-6.5;8.0-12.0;0.2-6.0;TIME REF CHANNEL; AND 0.55-0.75 MICRONS.A REFERENCE LEVEL WAS OBTAINED BY HAVING THE THR DETECTORS ALTERNATELY LOOK INTO SPACE AT A 45 DEGREE ANGLE. CHANNEL HAS THE SAME PRINCIPLE OF OPERATION: THE ALTERNATING VOLTAGE GENERATED AT THE THERMISTOR BOLOMETER IS PROPORTIONAL TO THE DIFFERENCE IN RADIATION ENERGY COMING FROM 2 OPPOSITE DIRECTIONS (THROUGH THE SATELLITE WALL AND BASE) AND IMPINGENT UPON A CHOPPER DISK THAT HAS ALTERNATE BLACK AND MIRRORED HALVES. ALL 5 DISKS ROTATE SIMULTANEOUSLY AT 46 RPS, AND HAVE IDENTICAL OUTPUT CIRCUITRY TO PREAMPLIFIERS AND TAPE RECORDERS. SATELLITE SPIN IS USED TO PROVIDE THE SCAN LINE, WHICH IS THEN ADVANCED BY ORBITAL MOTION OF THE SATELLITE. THE INSTRUMENT HAS A 5 DEG FOV FOR EACH CHANNEL. DATA ARE RECORDED ON THE SATELLITE'S ENDLESS LOOP OF MAGNETIC TAPE FOR A PERIOD OF 100 MIN.

32. PHENOMENA OBSERVED

RADIATION FROM EARTH AND ATMOSPHERE IN 5 SPECTRAL REGIONS

33. MEASUREMENT RANGE

34. PRECISION AND ACCURACY

A S/N RATIO OF BETTER THAN 30 DB;ABSOLUTE ACCURACY OF +-7 DEG K

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.25 TO 12.0 MICRONS	SEE ITEM 31	

38. FIELD OF VIEW	39. GROUND SWATH
5.0 DEG	35 NM DIAM CIRCLE FROM 450 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
5.0 DEG	35 NM AT NADIR FROM 450 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED CIRCULAR	MEDIUM POSIGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

RADIOMETER (5 THERMISTOR BOLOMETER DETECTORS) - ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
6 LB		3 WATTS			

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
			SENSITIVE	

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
SPACE LOOK FOR ZEROING	DELAYED TELEMETRY	CONTINUOUS

62. TELEMETRY REQUIREMENTS

7 FREQUENCY BANDS ARE USED FOR TOTAL IR PACKAGE (LOW + MED IR), THE 7 CHANNELS HAVE A WIDTH OF 310 HZ.

63. ADVANTAGES AND LIMITATIONS

AN UNCERTAINTY EXISTS IN THE ABSOLUTE VALUES OF THE MEASUREMENTS BECAUSE OF NO INFLIGHT CALIBRATION.

64. REFERENCES

1) TIROS 4 RADIATION DATA CATALOG AND USER'S MANUAL. GSFC, DEC. 63.***2) DATA CATALOG OF SATELLITE AND ROCKET EXPTS. NASA/GSFC-NATIONAL SPACE SCIENCE DATA CENTER, REPORT NO. NSSDC 68-01, JAN. 1968.***3) GOLDBERG, I.: MET INSTRUMENTS FOR SATELLITES. NASA/GSFC, AUG. 68.***4) DATA AVAILABLE FROM NATIONAL SPACE SCIENCE DATA CENTER, NASA/GSFC.

65. HISTORICAL REMARKS

SIMILAR RADIOMETERS FLOWN ON TIROS 2,3,4,7 AND NIMBUS 2 (MRIR)

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
VIDICON CAMERA SYSTEM	VCSM	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
MEDIUM-ANGLE LENS	11/10/69	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
RADOS, R. M. (MGR.)	GODDARD SPACE FLT CENTER	301-982-5347
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					POST FLIGHT

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GARBACZ, M.L.	NASA HDQTRS	OSSA/SRO	202-962-4291

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
RCA ASTRO-ELECTRONICS	PRINCETON, NEW JERSEY	02/62	NA

26. INSTRUMENT TYPE	27. SECURITY
IMAGER, 0.5-INCH MEDIUM ANGLE F/1.8 VIDICON	UNC

28. APPLICATION	29. SPACECRAFT
MET	TIROS 4

30. PURPOSE

PRIMARY-TO PROVIDE PICTURES OF EARTH'S CLOUD COVER AND INVESTIGATE FORMATIVE STAGES OF HURRICANES AND ATMOSPHERIC MOTIONS. *** SECONDARY-TO CONFIRM THE CAPABILITY OF USING A WEATHER SATELLITE FOR ICE RECONAISSANCE.

31. PRINCIPLES OF OPERATION

THIS MEDIUM ANGLE VIDICON CAMERA SYSTEM WAS ALSO FLOWN, IN IDENTICAL CONFIGURATION, ON TIROS 5 AND 6. IT CONSISTS OF A 1/2-INCH VIDICON TUBE AND A FOCAL-PLANE SHUTTER THAT PERMITS STORAGE OF STILL PICTURES ON THE TUBE SCREEN. AN ELECTRON BEAM CONVERTS THE STORED PICTURES INTO TELEVISION-TYPE ELECTRONIC SIGNALS, WHICH CAN BE TRANSMITTED TO GROUND RECEIVERS ON COMMAND. THE SYSTEM CAN ALSO PROCESS AND STORE UP TO 32 PICTURES ON MAGNETIC TAPE FOR TRANSMISSION AT A LATER TIME. THE CAMERA HAS A MEDIUM ANGLE (76 DEGREES) TEGEA F/1.8 LENS PRODUCING A RESOLUTION OF ABOUT 1.0 MILE. THE CAMERA HAS A SHUTTER SPEED OF 1.5 MILLISECONDS AND A VIDEO-BANDWIDTH OF 62.5 KHZ. THE 500 LINE FRAME IS PROCESSED FOR STORAGE IN 12 SECS. A MINIMUM INTERVAL, BETWEEN PICTURES, OF 10 SECONDS IS REQUIRED FOR THE TARGET IMAGE TO BE ELECTRICALLY ERASED. THE CAMERA IS ALIGNED PARALLEL TO THE SATELLITE'S SPIN AXIS AND IS AUTOMATICALLY TRIGGERED SO AS TO BE IN A PICTURE TAKING MODE ONLY WHEN DIRECTED TOWARD THE EARTH. TRANSMISSION OF THE ENTIRE REEL OF 32 PICTURES CAN BE ACCOMPLISHED IN 100 SECONDS BY A 2-WATT FM TRANSMITTER OPERATING AT A NOMINAL FREQUENCY OF 235 MHZ.

32. PHENOMENA OBSERVED

CLOUD COVER OVER THE EARTH'S SURFACE

33. MEASUREMENT RANGE

7 TO 8 LEVELS OF GRAY

34. PRECISION AND ACCURACY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.5 TO 0.65 MICRONS	NA	

38. FIELD OF VIEW	39. GROUND SWATH
56.0 BY 56.0 DEG	500 NM BY 500 NM FROM 450 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.12 DEG	1.0 NM PER TV-LINE FROM 450 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED CIRCULAR	MEDIUM POSIGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

TV CAMERA, TRANSMITTER, TAPE RECORDER

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
7 LB		9 WATTS	NONE	9 WATTS	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
	SENSITIVE			MAGNETIC SHIELDING USED

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
NO IN-FLIGHT CALIBRATION	DELAYED OR REALTIME	DAYSIDE OF ORBIT

62. TELEMETRY REQUIREMENTS

FULL REEL OF 32 PICTURES CAN BE READ OUT IN 100 SECONDS USING AN FM TRANSMITTER OPERATING AT FREQUENCY OF 235 MHZ.

63. ADVANTAGES AND LIMITATIONS

BROAD SYNOPTIC VIEWING OF CLOUD-COVER PATTERNS. VALUABLE FOR ICE STUDY AND ICE RECONNAISSANCE.

64. REFERENCES

1) SIGNIFICANT ACHIEVEMENTS IN SATELLITE METEOROLOGY, 1958-1964. NASA SP-96.***2) INSTRUMENTS AND SPACECRAFT, OCT 57-MAR 65. NASA SP-3028.***3) NASA NEWS RELEASES FOR TIROS 4, 5, 6. RELEASE NO'S 62-24; 62-136; 62-194.***4) DATA AVAILABLE FROM NATIONAL WEATHER RECORDS CENTER (ESSA) ASHEVILLE, N.C.

65. HISTORICAL REMARKS

IDENTICAL INSTRUMENTS FLOWN ON TIROS 4, 5, AND 6.

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
VIDICON CAMERA SYSTEM	VCSW	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
WIDE-ANGLE LENS	11/10/69	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
RADOS, R. M. (MGR.)	GODDARD SPACE FLT CENTER	301-982-5347
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					POST FLIGHT

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GARBACZ, M.L.	NASA HDQTRS	OSSA/SRO	202-962-4291

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
RCA ASTRO-ELECTRONICS	PRINCETON, NEW JERSEY	02/62	NA

26. INSTRUMENT TYPE	27. SECURITY
IMAGER, 0.5-INCH WIDE-ANGLE F/1.5 LOW-RESOLUTION VIDICON	UNC

28. APPLICATION	29. SPACECRAFT
MET	TIROS 4

30. PURPOSE

PRIMARY-TO ACQUIRE AND TRANSMIT PICTURES OF THE EARTH'S CLOUD COVER TO PROVIDE METEOROLOGISTS WITH DETAILED INFORMATION ON INDIVIDUAL CLOUD TYPES OVER SPECIFIC AREAS.***SECONDARY-TO TEST TV SENSOR IN SPACE.

31. PRINCIPLES OF OPERATION

THIS CAMERA SUB-SYSTEM HAS FLOWN IN AN IDENTICAL CONFIGURATION ON TIROS 1-10 AND SIMILAR CONFIGURATION ON ESSA 1. ON TIROS 1-8, 10 THE CAMERAS WERE ALIGNED PARALLEL TO THE S/C SPIN AXIS AND EXTENDED THROUGH THE BASE PLATE. IT CONSISTS OF A 1/2-IN VIDICON TUBE AND A FOCAL-PLANE SHUTTER THAT PERMITS STORAGE OF STILL PICTURES ON THE TUBE SCREEN. AN ELECTRON BEAM CONVERTS THE STORED PICTURES INTO TELEVISION-TYPE ELECTRONIC SIGNALS, WHICH CAN BE TRANSMITTED TO GROUND RECEIVERS ON COMMAND.THE SYSTEM CAN ALSO PROCESS AND STORE UP TO 32 PICTURES ON MAGNETIC TAPE FOR TRANSMISSION AT A LATER TIME. THE CAMERA HAS A WIDE ANGLE (105 DEG) ELGEET F/1.5 LENS PRODUCING A RESOLUTION OF 1.4 TO 2.0 NM. THE CAMERA HAS A SHUTTER SPEED OF 1.5 MILLISEC AND A VIDEO-BAND-WIDTH OF 62.5 KHZ. THE 500 LINE FRAME IS PROCESSED FOR STORAGE IN 2 SEC. A MINIMUM INTERVAL OF 10 SEC BETWEEN PICTURES IS REQUIRED FOR THE TARGET IMAGE TO BE ELECTRICALLY ERASED.THE CAMERA IS ALIGNED PARALLEL TO THE SATELLITE'S SPIN AXIS AND IS AUTOMATICALLY TRIGGERED SO AS TO BE IN A PICTURE TAKING MODE ONLY WHEN DIRECTED TOWARD THE EARTH. TRANSMISSION OF THE ENTIRE REEL OF 32 PICTURES CAN BE ACCOMPLISHED IN 100 SEC BY A 2-WATT FM TRANSMITTER OPERATING AT A NOMINAL FREQUENCY OF 235 MHZ.

32. PHENOMENA OBSERVED

CLOUD COVER AND THE EARTH'S SURFACE

33. MEASUREMENT RANGE

7 TO 8 LEVELS OF GRAY

34. PRECISION AND ACCURACY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.4 TO 0.65 MICRONS	NA	

38. FIELD OF VIEW	39. GROUND SWATH
74.0 BY 74.0 DEG	750 NM BY 750 NM FROM 475 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.2 DEG	1.5 NM PER TV-LINE FROM 475 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED CIRCULAR	MEDIUM POSIGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

TV CAMERA, TRANSMITTER, TAPE RECORDER

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
7 LB		9 WATTS	NONE	9 WATTS	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
	SENSITIVE			MAGNETIC SHIELDING USED

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
NO IN-FLIGHT CALIBRATION	DELAYED AND REALTIME	DAYSIDE OF ORBIT

62. TELEMETRY REQUIREMENTS

FULL REEL OF 32 PICTURES CAN BE READ OUT IN 100 SECONDS USING AN FM TRANSMITTER OPERATING AT FREQUENCY OF 235 MHZ.

63. ADVANTAGES AND LIMITATIONS

BROAD SYNOPTIC VIEWING OF CLOUD COVER PATTERNS. MORE VALUABLE DATA FOR WEATHER ANALYSIS THAN FROM MED OR NARROW ANGLE CAMERAS

64. REFERENCES

1) SIGNIFICANT ACHIEVEMENTS IN SAT MET 1958-1964. NASA SP-96.*** 2) GOLDBERG, E.A. AND LANDON, V.D.: KEY EQUIP FOR TIROS 1. ASTRONAUTICS, V.5, JUNE 1960.***3) MESNER, M.H. AND STANISZEWSKI, J.: TV CAMERAS FOR SPACE EXPLOR. ASTRONAUTICS, V.5, MAY 1960.*** 4) INSTRUMENTS AND SPACECRAFT. NASA SP-3028, 1966. ***5) DATA AVAILABLE FROM NATIONAL WEATHER RECORDS CTR (ESSA),ASHEVILLE,NC.

65. HISTORICAL REMARKS

IDENTICAL CAMERA FLOWN ON TIROS 1-10. SIMILAR CAMERA ON ESSA 1.

66. DIAGRAMS

TIROS 5

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
VIDICON CAMERA SYSTEM	VCSM	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
MEDIUM-ANGLE LENS	11/10/69	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
BADOS, R.M. (MGR.)	GODDARD SPACE FLT CENTER	301-982-5347
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					POST FLIGHT

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GARBACZ, M.L.	NASA HDQTRS	OSSA/SRO	202-962-4291

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
RCA ASTRO-ELECTRONICS	PRINCETON, NEW JERSEY	06/62	NA

26. INSTRUMENT TYPE	27. SECURITY
IMAGER, 0.5-INCH MEDIUM-ANGLE F/1.8 VIDICON	UNC

28. APPLICATION	29. SPACECRAFT
MET	TIROS 5

30. PURPOSE

PRIMARY-TO PROVIDE PICTURES OF EARTH'S CLOUD COVER AND INVESTIGATE FORMATIVE STAGES OF HURRICANES AND ATMOSPHERIC MOTIONS. *** SECONDARY-TO CONFIRM THE CAPABILITY OF USING A WEATHER SATELLITE FOR ICE RECONAISSANCE.

31. PRINCIPLES OF OPERATION

THIS MEDIUM ANGLE VIDICON CAMERA SYSTEM WAS ALSO FLOWN, IN IDENTICAL CONFIGURATION, ON TIROS 4 AND 6. IT CONSISTS OF A 1/2-INCH VIDICON TUBE AND A FOCAL-PLANE SHUTTER THAT PERMITS STORAGE OF STILL PICTURES ON THE TUBE SCREEN. AN ELECTRON BEAM CONVERTS THE STORED PICTURES INTO TELEVISION-TYPE ELECTRONIC SIGNALS, WHICH CAN BE TRANSMITTED TO GROUND RECEIVERS ON COMMAND. THE SYSTEM CAN ALSO PROCESS AND STORE UP TO 32 PICTURES ON MAGNETIC TAPE FOR TRANSMISSION AT A LATER TIME. THE CAMERA HAS A MEDIUM ANGLE (76 DEGREES) TEGEA F/1.8 LENS PRODUCING A RESOLUTION OF ABOUT 1.0 NM. THE CAMERA HAS A SHUTTER SPEED OF 1.5 MILLISECONDS AND A VIDEO-BANDWIDTH OF 62.5 KHZ. THE 500 LINE FRAME IS PROCESSED FOR STORAGE IN 12 SECS. A MINIMUM INTERVAL, BETWEEN PICTURES, OF 10 SECONDS IS REQUIRED FOR THE TARGET IMAGE TO BE ELECTRICALLY ERASED. THE CAMERA IS ALIGNED PARALLEL TO THE SATELLITE'S SPIN AXIS AND IS AUTOMATICALLY TRIGGERED SO AS TO BE IN A PICTURE TAKING MODE ONLY WHEN DIRECTED TOWARD THE EARTH. TRANSMISSION OF THE ENTIRE REEL OF 32 PICTURES CAN BE ACCOMPLISHED IN 100 SECONDS BY A 2-WATT FM TRANSMITTER OPERATING AT A NOMINAL FREQUENCY OF 235 MHZ.

32. PHENOMENA OBSERVED

CLOUD COVER OVER THE EARTH'S SURFACE

33. MEASUREMENT RANGE

7 TO 8 LEVELS OF GRAY

34. PRECISION AND ACCURACY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.5 TO 0.65 MICRONS	NA	

38. FIELD OF VIEW	39. GROUND SWATH
56.0 BY 56.0 DEG	480 NM BY 480 NM FROM 450 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.12 DEG	1.0 NM PER TV-LINE FROM 450 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED CIRCULAR	MEDIUM POSIGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

TV CAMERA, TRANSMITTER, TAPE RECORDER

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
7 LB		9 WATTS	NONE	9 WATTS	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
	SENSITIVE			MAGNETIC SHIELDING USED

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
NO IN-FLIGHT CALIBRATION	DELAYED OR REALTIME	DAY SIDE OF ORBIT

62. TELEMETRY REQUIREMENTS

FULL REEL OF 32 PICTURES CAN BE READ OUT IN 100 SECONDS USING AN FM TRANSMITTER OPERATING AT FREQUENCY OF 235 MHZ.

63. ADVANTAGES AND LIMITATIONS

BROAD SYNOPTIC VIEWING OF CLOUD COVER PATTERNS. VALUABLE FOR ICE STUDY AND ICE RECONNAISSANCE.

64. REFERENCES

1) SIGNIFICANT ACHIEVEMENTS IN SATELLITE METEOROLOGY, 1958-1964. NASA SP-96.***2) INSTRUMENTS AND SPACECRAFT, OCT 57-MAR 65. NASA SP-3028.***3) NASA NEWS RELEASES FOR TIROS 4, 5, 6. RELEASE NO'S 62-24; 62-136; 62-194.***4) DATA AVAILABLE FROM NATIONAL WEATHER RECORDS CENTER (ESSA) ASHEVILLE, N.C.

65. HISTORICAL REMARKS

IDENTICAL INSTRUMENTS FLOWN ON TIROS 4, 5, AND 6.

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
VIDICON CAMERA SYSTEM	VCSW	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
WIDE-ANGLE LENS	11/10/69	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
RADOS, R. M. (MGR.)	GODDARD SPACE FLT CENTER	301-982-5347
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					POST FLIGHT

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GARBACZ, M.L.	NASA HDQTRS	OSSA/SRO	202-962-4291

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
RCA ASTRO-ELECTRONICS	PRINCETON, NEW JERSEY	06/62	NA

26. INSTRUMENT TYPE	27. SECURITY
IMAGER, 0.5-INCH WIDE-ANGLE F/1.5 LOW-RESOLUTION VIDICON	UNC

28. APPLICATION	29. SPACECRAFT
MET	TIROS 5

30. PURPOSE

PRIMARY-TO ACQUIRE AND TRANSMIT PICTURES OF THE EARTH'S CLOUD COVER TO PROVIDE METEOROLOGISTS WITH DETAILED INFORMATION ON INDIVIDUAL CLOUD TYPES OVER SPECIFIC AREAS.***SECONDARY-TO TEST TV SENSOR IN SPACE.

31. PRINCIPLES OF OPERATION

THIS CAMERA SUB-SYSTEM HAS FLOWN IN AN IDENTICAL CONFIGURATION ON TIROS 1-10 AND SIMILAR CONFIGURATION ON ESSA 1. ON TIROS 1-8, 10 THE CAMERAS WERE ALIGNED PARALLEL TO THE S/C SPIN AXIS AND EXTENDED THROUGH THE BASE PLATE. IT CONSISTS OF A 1/2-IN VIDICON TUBE AND A FOCAL-PLANE SHUTTER THAT PERMITS STORAGE OF STILL PICTURES ON THE TUBE SCREEN. AN ELECTRON BEAM CONVERTS THE STORED PICTURES INTO TELEVISION-TYPE ELECTRONIC SIGNALS, WHICH CAN BE TRANSMITTED TO GROUND RECEIVERS ON COMMAND. THE SYSTEM CAN ALSO PROCESS AND STORE UP TO 32 PICTURES ON MAGNETIC TAPE FOR TRANSMISSION AT A LATER TIME. THE CAMERA HAS A WIDE ANGLE(105 DEG) ELGEET F/1.5 LENS PRODUCING A RESOLUTION OF 1.4 TO 2.0 NM. THE CAMERA HAS A SHUTTER SPEED OF 1.5 MILLISEC AND A VIDEO-BANDWIDTH OF 62.5 KHZ. THE 500 LINE FRAME IS PROCESSED FOR STORAGE IN 2 SEC. A MINIMUM INTERVAL OF 10 SEC BETWEEN PICTURES IS REQUIRED FOR THE TARGET IMAGE TO BE ELECTRICALLY ERASED. THE CAMERA IS ALIGNED PARALLEL TO THE SATELLITE'S SPIN AXIS AND IS AUTOMATICALLY TRIGGERED SO AS TO BE IN A PICTURE TAKING MODE ONLY WHEN DIRECTED TOWARD THE EARTH. TRANSMISSION OF THE ENTIRE REEL OF 32 PICTURES CAN BE ACCOMPLISHED IN 100 SEC BY A 2-WATT FM TRANSMITTER OPERATING AT A NOMINAL FREQUENCY OF 235 MHZ.

32. PHENOMENA OBSERVED

CLOUD COVER AND THE EARTH'S SURFACE

33. MEASUREMENT RANGE

7 TO 8 LEVELS OF GRAY

34. PRECISION AND ACCURACY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.5 TO 0.65 MICRONS	NA	

38. FIELD OF VIEW	39. GROUND SWATH
74.0 BY 74.0 DEG	740 NM BY 740 NM FROM 450 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.2 DEG	1.5 NM PER TV-LINE FROM 450 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED CIRCULAR	MEDIUM POSIGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

TV CAMERA, TRANSMITTER, TAPE RECORDER

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
7 LB		9 WATTS	NONE	9 WATTS	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
	SENSITIVE			MAGNETIC SHIELDING USED

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
NO IN-FLIGHT CALIBRATION	DELAYED AND REALTIME	DAYSIDE OF ORBIT

62. TELEMETRY REQUIREMENTS

FULL REEL OF 32 PICTURES CAN BE READ OUT IN 100 SECONDS USING AN FM TRANSMITTER OPERATING AT FREQUENCY OF 235 MHZ.

63. ADVANTAGES AND LIMITATIONS

BROAD SYNOPTIC VIEWING OF CLOUD COVER PATTERNS. MORE VALUABLE DATA FOR WEATHER ANALYSIS THAN FROM MED OF NARROW ANGLE CAMERAS

64. REFERENCES

1) SIGNIFICANT ACHIEVEMENTS IN SAT MET 1958-1964. NASA SP-96.*** 2) GOLDBERG, E.A. AND LANDON, V.D.: KEY EQUIP FOR TIROS 1. ASTRONAUTICS, V.5, JUNE 1960.***3) MESNER, M.H. AND STANISZEWSKI, J.: TV CAMERAS FOR SPACE EXPLOR. ASTRONAUTICS, V.5, MAY 1960.*** 4) INSTRUMENTS AND SPACECRAFT. NASA SP-3028, 1966. ***5) DATA AVAILABLE FROM NATIONAL WEATHER RECORDS CTR (ESSA), ASHEVILLE, NC.

65. HISTORICAL REMARKS

IDENTICAL CAMERA FLOWN ON TIROS 1-10. SIMILAR CAMERA ON ESSA 1.

66. DIAGRAMS

TIROS 6

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
VIDICON CAMERA SYSTEM	VCSM	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
MEDIUM-ANGLE LENS	11/10/69	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
RADOS, R. M. (MGR.)	GODDARD SPACE FLT CENTER	301-982-5347
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					POST FLIGHT

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GARBACZ, M.L.	NASA HDQTRS	OSSA/SRO	202-962-4291

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
RCA ASTRO-ELECTRONICS	PRINCETON, NEW JERSEY	09/62	NA

26. INSTRUMENT TYPE	27. SECURITY
IMAGER, 0.5-INCH MEDIUM-ANGLE F/1.8 VIDICON	UNC

28. APPLICATION	29. SPACECRAFT
MET	TIROS 6

30. PURPOSE

PRIMARY-TO PROVIDE PICTURES OF EARTH'S CLOUD COVER AND INVESTIGATE FORMATIVE STAGES OF HURRICANES AND ATMOSPHERIC MOTIONS.*** SECONDARY-TO CONFIRM THE CAPABILITY OF USING A WEATHER SATELLITE FOR ICE RECONAISSANCE.

31. PRINCIPLES OF OPERATION

THIS MEDIUM ANGLE VIDICON CAMERA SYSTEM WAS ALSO FLOWN, IN IDENTICAL CONFIGURATION, ON TIROS 4 AND 5. IT CONSISTS OF A 1/2-INCH VIDICON TUBE AND A FOCAL-PLANE SHUTTER THAT PERMITS STORAGE OF STILL PICTURES ON THE TUBE SCREEN.AN ELECTRON BEAM CONVERTS THE STORED PICTURES INTO TELEVISION-TYPE ELECTRONIC SIGNALS, WHICH CAN BE TRANSMITTED TO GROUND RECEIVERS ON COMMAND. THE SYSTEM CAN ALSO PROCESS AND STORE UP TO 32 PICTURES ON MAGNETIC TAPE FOR TRANSMISSION AT A LATER TIME. THE CAMERA HAS A MEDIUM ANGLE (76 DEGREES) TEGEA F/1.8 LENS PRODUCING A RESOLUTION OF ABOUT 1.0 MILE. THE CAMERA HAS A SHUTTER SPEED OF 1.5 MILLISECONDS AND A VIDEO-BANDWIDTH OF 62.5 KHZ. THE 500 LINE FRAME IS PROCESSED FOR STORAGE IN 12 SECS. A MINIMUM INTERVAL,BETWEEN PICTURES, OF 10 SECONDS IS REQUIRED FOR THE TARGET IMAGE TO BE ELECTRICALLY ERASED. THE CAMERA IS ALIGNED PARALLEL TO THE SATELLITE'S SPIN AXIS AND IS AUTOMATICALLY TRIGGERED SO AS TO BE IN A PICTURE TAKING MODE ONLY WHEN DIRECTED TOWARD THE EARTH. TRANSMISSION OF THE ENTIRE REEL OF 32 PICTURES CAN BE ACCOMPLISHED IN 100 SECONDS BY A 2-WATT FM TRANSMITTER OPERATING AT A NOMINAL FREQUENCY OF 235 MHZ.

32. PHENOMENA OBSERVED

CLOUD COVER OVER THE EARTH'S SURFACE

33. MEASUREMENT RANGE

7 TO 8 LEVELS OF GRAY

34. PRECISION AND ACCURACY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.5 TO 0.65 MICRONS	NA	

38. FIELD OF VIEW	39. GROUND SWATH
56.0 BY 56.0 DEG	450 NM BY 450 NM FROM 400 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.12 DEG	.84 NM/TV LINE FROM 400 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED CIRCULAR	MEDIUM POSIGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

TV,CAMERA, TRANSMITTER,TAPE RECORDER

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
7 LB		9 WATTS	NONE	9 WATTS	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
	SENSITIVE			MAGNETIC SHIELDING USED

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
NO IN-FLIGHT CALIBRATION	DELAYED OR REALTIME	DAY SIDE OF ORBIT

62. TELEMETRY REQUIREMENTS

FULL REEL OF 32 PICTURES CAN BE READ OUT IN 100 SECONDS USING AN FM TRANSMITTER OPERATING AT FREQUENCY OF 235 MHZ.

63. ADVANTAGES AND LIMITATIONS

BROAD SYNOPTIC VIEWING OF CLOUD COVER PATTERNS. VALUABLE FOR ICE STUDY AND ICE RECONNAISSANCE.

64. REFERENCES

1) SIG.ACHIEV.IN SAT.MET.1958-1964.NASA SP-96.***2) INSTRUMENTS AND SPACECRAFT OCT 57-MAR 65. NASA SP-3028.***3) NASA NEWS RELEASES FOR TIROS 4,5,6. RELEASE NO'S. 62-24;62-136;62-194.*** 4) DATA AVAILABLE FROM NATIONAL WEATHER RECORDS CTR (ESSA) ASHEVILLE,N.C.

65. HISTORICAL REMARKS

IDENTICAL INSTRUMENTS FLOWN ON TIROS 4, 5, AND 6.

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE			2. ACRONYM	3. EXP NO
VIDICON CAMERA SYSTEM			VCSW	
(TITLE CONT.)			4. RESUME DATE	5. VERSION
WIDE-ANGLE LENS			11/10/69	0005
6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE		
RADOS, R. M. (MGR.)	GODDARD SPACE FLT CENTER	301-982-5347		
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE		

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					POST FLIGHT

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GARBACZ, M.L.	NASA HDQTRS	OSSA/SRO	202-962-4291

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
RCA ASTRO-ELECTRONICS	PRINCETON, NEW JERSEY	09/62	NA

26. INSTRUMENT TYPE	27. SECURITY
IMAGER, 0.5-INCH WIDE-ANGLE F/1.5 LOW-RESOLUTION VIDICON	

28. APPLICATION	29. SPACECRAFT
MET	TIROS 6

30. PURPOSE

PRIMARY-TO ACQUIRE AND TRANSMIT PICTURES OF THE EARTH'S CLOUD COVER TO PROVIDE METEOROLOGISTS WITH DETAILED INFORMATION ON INDIVIDUAL CLOUD TYPES OVER SPECIFIC AREAS.***SECONDARY-TO TEST TV SENSOR IN SPACE.

31. PRINCIPLES OF OPERATION

THIS CAMERA SUB-SYSTEM HAS FLOWN IN AN IDENTICAL CONFIGURATION ON TIROS 1-10 AND SIMILAR CONFIGURATION ON ESSA 1. ON TIROS 1-8, 10 THE CAMERAS WERE ALIGNED PARALLEL TO THE S/C SPIN AXIS AND EXTENDED THROUGH THE BASE PLATE. IT CONSISTS OF A 1/2-IN VIDICON TUBE AND A FOCAL-PLANE SHUTTER THAT PERMITS STORAGE OF STILL PICTURES ON THE TUBE SCREEN. AN ELECTRON BEAM CONVERTS THE STORED PICTURES INTO TELEVISION-TYPE ELECTRONIC SIGNALS, WHICH CAN BE TRANSMITTED TO GROUND RECEIVERS ON COMMAND. THE SYSTEM CAN ALSO PROCESS AND STORE UP TO 32 PICTURES ON MAGNETIC TAPE FOR TRANSMISSION AT A LATER TIME. THE CAMERA HAS A WIDE ANGLE(105 DEG) ELGEET F/1.5 LENS PRODUCING A RESOLUTION OF 1.4 TO 2.0 NM. THE CAMERA HAS A SHUTTER SPEED OF 1.5 MILLISEC AND A VIDEO-BANDWIDTH OF 62.5 KHZ. THE 500 LINE FRAME IS PROCESSED FOR STORAGE IN 2 SEC. A MINIMUM INTERVAL OF 10 SEC BETWEEN PICTURES IS REQUIRED FOR THE TARGET IMAGE TO BE ELECTRICALLY ERASED. THE CAMERA IS ALIGNED PARALLEL TO THE SATELLITE'S SPIN AXIS AND IS AUTOMATICALLY TRIGGERED SO AS TO BE IN A PICTURE TAKING MODE ONLY WHEN DIRECTED TOWARD THE EARTH. TRANSMISSION OF THE ENTIRE REEL OF 32 PICTURES CAN BE ACCOMPLISHED IN 100 SEC BY A 2-WATT FM TRANSMITTER OPERATING AT A NOMINAL FREQUENCY OF 235 MHZ.

32. PHENOMENA OBSERVED

CLOUD COVER AND THE EARTH'S SURFACE

33. MEASUREMENT RANGE

7 TO 8 LEVELS OF GRAY

34. PRECISION AND ACCURACY

35. SPECTRAL RANGE		36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.5 TO 0.65 MICRONS, NA			

38. FIELD OF VIEW	39. GROUND SWATH
74.0 BY 74.0 DEG	725 NM BY 725 NM FROM 400 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.2 DEG	1.4 NM PER TV LINE FROM 400 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED CIRCULAR	MEDIUM POSIGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

TV CAMERA, TRANSMITTER, TAPE RECORDER

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
7 LB		9 WATTS	NONE	9 WATTS	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
	SENSITIVE			MAGNETIC SHIELDING USED

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
NO IN-FLIGHT CALIBRATION	DELAYED AND REALTIME; DAYSIDE OF ORBIT	

62. TELEMETRY REQUIREMENTS

FULL REEL OF 32 PICTURES CAN BE READ OUT IN 100 SECONDS USING AN FM TRANSMITTER OPERATING AT FREQUENCY OF 235 MHZ.

63. ADVANTAGES AND LIMITATIONS

BROAD SYNOPTIC VIEWING OF CLOUD-COVER PATTERNS. MORE VALUABLE DATA FOR WEATHER ANALYSIS THAN FROM MED OR NARROW ANGLE CAMERAS

64. REFERENCES

1) SIGNIFICANT ACHIEVEMENTS IN SAT MET 1958-1964. NASA SP-96.*** 2) GOLDBERG, E.A. AND LANDON, V.D.: KEY EQUIP FOR TIROS 1. ASTRONAUTICS, V.5, JUNE 1960.***3) MESNER, M.H. AND STANISZEWSKI, J.: TV CAMERAS FOR SPACE EXPLOR. ASTRONAUTICS, V.5, MAY 1960.*** 4) INSTRUMENTS AND SPACECRAFT. NASA SP-3028, 1966. ***5) DATA AVAILABLE FROM NATIONAL WEATHER RECORDS CTR (ESSA), ASHEVILLE, NC.

65. HISTORICAL REMARKS

IDENTICAL CAMERA FLOWN ON TIROS 1-10. SIMILAR CAMERA ON ESSA 1.

66. DIAGRAMS

TIROS 7

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
ELECTRON TEMPERATURE PROBE	ETP	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0003

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
SPENCER, N.W.	GODDARD SPACE FLT CENTER	301-982-5001
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
BRACE, L.H.	GODDARD SPACE FLT CENTER	301-982-4575

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					POST FLIGHT

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GARBACZ, M.L.	NASA HDQTRS	OSSA/SRO	202-962-4291

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
		06/63	NA

26. INSTRUMENT TYPE	27. SECURITY
COUNTER, THERMAL-ELECTRON	UNC

28. APPLICATION	29. SPACECRAFT
MET	TIROS 7

30. PURPOSE

PRIMARY-TO MEASURE IONOSPHERIC ELECTRON TEMPERATURE AND DENSITY, AND POSITIVE ION DENSITY OF THE PLASMA IN THE VICINITY OF THE SPACECRAFT.

31. PRINCIPLES OF OPERATION

THE TIROS 7 ELECTRON TEMPERATURE PROBE IS SIMILAR TO THE PROBE FLOWN ON EXPLORER 11 AND 22. THE SENSOR CONSISTS OF A 5-INCH GUARD ELECTRODE AND A 9-INCH COLLECTOR OF 0.022-INCH DIAMETER MOUNTED ON THE SPACECRAFT BASEPLATE (PROJECTING INTO THE PLASMA). THE GUARD PREVENTS THE COLLECTION OF CURRENT IN THE REGION IMMEDIATELY ADJACENT TO THE SPACECRAFT AND THEREFORE AVOIDS ANY POSSIBLE RELATED DISTURBANCE OF THE MEASUREMENTS. AN APPROPRIATE SAW-TOOTH SHAPED VOLTAGE (-3 TO +5 VOLTS) IS APPLIED BETWEEN THE CYLINDRICAL ELECTRODE AND SATELLITE SHELL AND THE RESULTING CURRENT IS MONITORED. MAGNITUDE AND SHAPE OF THE CURRENT CURVE IS DETERMINED BY THE APPLIED VOLTAGE, THE ION AND ELECTRON CONTENT OF THE SATELLITE, PHOTO EMISSION OF THE ELECTRODE, AND THE AMBIENT ELECTRON AND ION TEMPERATURE. SINCE THE RELATIVE CONTRIBUTION OF THESE EFFECTS CAN BE EVALUATED, ELECTRON TEMPERATURE AND DENSITY, AND POSITIVE ION DENSITY MAY BE DEDUCED FROM ANALYSIS OF THE VOLT-AMPERE CURVES.

32. PHENOMENA OBSERVED

AMBIENT THERMAL ELECTRONS AND IONS

33. MEASUREMENT RANGE

34. PRECISION AND ACCURACY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
NA	NA	

38. FIELD OF VIEW	39. GROUND SWATH
NA	NA

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
NA	NA	MED CIRCULAR	MEDIUM POSIGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

GUARD ELECTRODE, COLLECTOR, POWER SOURCE

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
2 LB		2 WATTS			

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
		SENSITIVE!		GUARD ELECTRODE PROVIDED

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
PERIODIC RESISTOR MEAS	DELAYED TELEMETRY	CONTINUOUS

62. TELEMETRY REQUIREMENTS

ANALOG OUTPUT REQUIRES ABOUT 50 HZ RESPONSE OR 50 SAMPLES PER SECOND DIGITAL WORDS.

63. ADVANTAGES AND LIMITATIONS

64. REFERENCES

1) INSTRUMENTS AND SPACECRAFT-OCT 57-MAR 65. NASA SP-3028.1966.***2) MISSION PLAN TIROS 7, REPORT NO X-650-63-99, MAY 1963, NASA/GSFC.***3) SATELLITE AND ROCKET EXPERIMENTS DATA CATALOG. NASA/NATIONAL SPACE SCIENCE DATA CENTER, JAN.68.***4) BRACE, L.H. AND REDDY, B.M.: EARLY ELECTROSTATIC PROBE RESULTS FROM EXPLORER 22. JGR, V.1, DEC.1, 1965.***5) DATA AVAILABLE FROM NASA/GSFC/NSSDC.

65. HISTORICAL REMARKS

SIMILAR PROBE FLOWN ON EXPLORER 11 AND 22.

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
LOW-RESOLUTION OMNIDIRECTIONAL RADIOMETER	LROR	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
SUOMI, DR. V.E.	UNIVERSITY OF WISCONSIN	608-262-5938
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
PARENT, DR. R. J.	UNIVERSITY OF WISCONSIN	608-262-5938

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					POST FLIGHT

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GARBACZ, M.L.	NASA HDQTRS	OSSA/SRO	202-962-4291

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
UNIVERSITY OF WISCONSIN	MADISON, WISCONSIN	06/63	NA

26. INSTRUMENT TYPE	27. SECURITY
RADIOMETER, IR OMNIDIRECTIONAL NON-SCANNING LOW-RESOLUTION	UNC

28. APPLICATION	29. SPACECRAFT
MET	TIROS 7

30. PURPOSE

PRIMARY- TO MEASURE THE GROSS HEAT BUDGET OF THE EARTH.*** SECONDARY-TO DETERMINE HOW MUCH SOLAR ENERGY IS ABSORBED, REFLECTED, AND EMITTED BY THE EARTH AND ITS ATMOSPHERE AT THE UPPER BOUNDARY; THUS TO STUDY THE PRIME DRIVING FORCE OF THE CIRCULATION OF THE ATMOSPHERE.

31. PRINCIPLES OF OPERATION

THIS EXPERIMENT WAS FLOWN IN AN IDENTICAL CONFIGURATION ON TIROS 3, 4, AND 7, AND WAS ALSO SIMILAR TO ONE ON EXPLORER 7. TWO WIDE ANGLE (180 DEG FOV) LOW-RESOLUTION IR DETECTION DEVICES, EACH COMPOSED OF A BLACK-AND-WHITE BOLOMETER AND A REFLECTING MIRROR, ARE MOUNTED 180-DEGREES APART ON TELESCOPING SUPPORTS SO THAT THE SATELLITE DOES NOT INTERFERE WITH THE FIELD-OF-VIEW. THE MIRRORS SHIELD EACH SENSOR FROM DIRECT RADIATION EMITTED BY THE SATELLITE'S BODY. BOTH BOLOMETERS HAVE A HIGH ABSORPTIVITY TO THE IR RADIATION FROM THE EARTH. THE BLACK BOLOMETER ALSO HAS A HIGH ABSORPTIVITY FOR SOLAR RADIATION. THUS BOTH REFLECTED AND EMITTED RADIATION CAN BE MEASURED. THE TEMPERATURE OF THE HEMISPHERES IS GIVEN BY ATTACHED TERMISTORS. MATCHED PAIRS OF THERMISTORS ARE CONNECTED IN SERIES WITH SIMILAR SENSORS ON OPPOSITE SIDES OF THE SPACECRAFT; THEREFORE, THE MEASURED SENSOR TEMPERATURE RECEIVED FROM THE SATELLITE IS AN AVERAGE OF TWO TEMPERATURES FROM MATCHED THERMISTORS AND SIMULATES THE RESPONSE OF AN ISOLATED SPHERE IN SPACE. THE INFORMATION TELEMETERED TO EARTH INCLUDES TEMPERATURES OF THE MIRRORS AND SENSORS AND A FIXED RESISTANCE VALUE WHICH ALLOWS ONE TO COMPENSATE FOR DRIFT OF THE ELECTRONICS IN THE SATELLITE.

32. PHENOMENA OBSERVED

RADIANT ENERGY REFLECTED AND EMMITTED BY THE EARTH.

33. MEASUREMENT RANGE

128 DEG K TO 488 DEG K

34. PRECISION AND ACCURACY

0.1 KELVIN DEGREE

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.3 TO 60.0 MICRON	NA	5. SECONDS

38. FIELD OF VIEW	39. GROUND SWATH
180.0 DEG	400 NM RADIUS CIRCLE FROM 400 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
NA	

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
NA	NA	MED CIRCULAR	MEDIUM POSIGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

2 DETECTION DEVICES, ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
3 LB					

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
				SENSITIVE MIRRORS SHIELD SENSORS

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
	DELAYED TELEMETRY	CONTINUOUS

62. TELEMETRY REQUIREMENTS

DATA FROM THIS AND OTHER IR EXPTS ON-BOARD ARE RECORDED CONTINUOUSLY FOR ONE ORBIT ON MAGNETIC TAPE FOR PLAYBACK ON COMMAND FROM ONE OF THE GROUND STATIONS.

63. ADVANTAGES AND LIMITATIONS

64. REFERENCES

1) HOUSE, F.B., RADIATION BALANCE OF THE EARTH FROM A SATELLITE, PHD THESIS, U. OF WISC. 1965.***2) VONDERHAAR, T.H., VARIATIONS OF THE EARTH'S RADIATION BUDGET, PHD THESIS, U. OF WISC. 1968.***
3) MISSION PLAN TIROS 7, GSFC RPT NO. X-650-63-99, MAY 1963.***
4) DATA AVAILABLE FROM NATIONAL SPACE SCIENCE DATA CENTER, NASA/GSFC.

65. HISTORICAL REMARKS

IDENTICAL INSTRUMENT FLOWN ON TIROS 3,4,AND 7;SIMILAR ON EXP 7

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
MEDIUM-RESOLUTION RADIOMETER	MRR	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
MCCULLOCH, A.	GODDARD SPACE FLT CENTER	301-982-4347
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					POST FLIGHT

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GARBACZ, M.L.	NASA HDQTRS	OSSA/SRO	202-962-4291

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
BARNES ENGINEERING CO	STAMFORD, CONN.	06/63	NA

26. INSTRUMENT TYPE	27. SECURITY
RADIOMETER, 5-CHANNEL THERMISTOR-BOLOMETER MED-RES SCANNING	UNC

28. APPLICATION	29. SPACECRAFT
MET	TIROS 7

30. PURPOSE

PRIMARY-TO MEASURE EMITTED THERMAL AND REFLECTED SOLAR RADIATION FROM THE EARTH AND ITS ATMOSPHERE IN 5 SPECTRAL REGIONS. PARAMETERS TO BE STUDIED ARE STRATOSPHERIC TEMPERATURES VIA THE 15 MICRON ABSORPTION BAND OF CO2, DAY-NIGHTTIME CLOUD COVER, ALBEDO, AND THERMAL RADIATION. TO GENERATE RADIATION MAPS FOR RESEARCH IN ATMOSPHERIC PROPERTIES.

31. PRINCIPLES OF OPERATION

TIROS 2,3,4,7, AND NIMBUS 2 CONTAINED 5 CHANNEL SCANNING RADIOMETERS USING FILTERS AND BOLOMETER DETECTORS. THE NIMBUS 2 RADIOMETER, WHILE SIMILAR IN PURPOSE, WAS A NEW INSTRUMENT DESIGN. ON THE TIROS SERIES PRECISE BANDWIDTHS VARIED FOR EACH FLIGHT, FOR TIROS 7 THEY WERE: 14.8-15.5; 8.0-12.0; 0.2-6.0; 8.0-30.0; AND 0.55-0.75 MICRONS. A REFERENCE LEVEL WAS OBTAINED BY HAVING THE DETECTORS ALTERNATELY LOOK INTO SPACE AT 45 DEGREE ANGLE. EACH CHANNEL HAS THE SAME PRINCIPLE OF OPERATION: THE ALTERNATING VOLTAGE GENERATED AT THE THERMISTOR BOLOMETER IS PROPORTIONAL TO THE DIFFERENCE IN RADIATION ENERGY COMING FROM 2 OPPOSITE DIRECTIONS (THROUGH THE SATELLITE WALL AND BASE) AND IMPINGENT UPON A CHOPPER DISK THAT HAS ALTERNATE BLACK AND MIRRORED HALVES. ALL 5 DISKS ROTATE SIMULTANEOUSLY AT 46 RPS AND HAVE IDENTICAL OUTPUT CIRCUITRY TO PREAMPLIFIERS AND TAPE RECORDERS. SATELLITE SPIN IS USED TO PROVIDE THE SCAN LINE, WHICH IS THEN ADVANCED BY ORBITAL MOTION OF THE SATELLITE. THE INSTRUMENT HAS A 5 DEG FOV FOR EACH CHANNEL. DATA ARE RECORDED ON THE SATELLITE'S ENDLESS LOOP OF MAGNETIC TAPE FOR A PERIOD OF 100 MIN.

32. PHENOMENA OBSERVED

RADIATION FROM EARTH AND ATMOSPHERE IN 5 SPECTRAL REGIONS

33. MEASUREMENT RANGE

34. PRECISION AND ACCURACY

A S/N RATIO OF BETTER THAN 30 DB; ABSOLUTE ACCURACY OF +-7 DEG K

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.25 TO 30.0 MICRONS	SEE ITEM 31	

38. FIELD OF VIEW	39. GROUND SWATH
5.0 DEG	35 NM DIAM CIRCLE FROM 400 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
5.0 DEG	35 NM AT CENTER FROM 400 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED CIRCULAR	MEDIUM POSIGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

RADIOMETER (5 THERMISTOR BOLOMETER DETECTORS) - ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
6 LB		3 WATTS			

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
			SENSITIVE	

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
SPACE LOOK FOR ZEROING	DELAYED TELEMETRY	CONTINUOUS

62. TELEMETRY REQUIREMENTS

7 FREQUENCY BANDS ARE USED FOR TOTAL IR PACKAGE (LOW + MED IR), THE 7 CHANNELS HAVE A WIDTH OF 310 HZ.

63. ADVANTAGES AND LIMITATIONS

AN UNCERTAINTY EXISTS IN THE ABSOLUTE VALUES OF THE MEASUREMENTS BECAUSE OF NO INFLIGHT CALIBRATION.

64. REFERENCES

1) TIROS 7 RADIATION DATA CATALOG AND USER'S MANUAL V.1,GSFC,SEPT 30,64.***2) DATA CATALOG OF SATELLITE AND ROCKET EXPTS. NSSDC 68-01, JAN 68. NASA/GSFC NATIONAL SPACE SCIENCE DATA CTR.***3) MISSION PLAN TIROS 7,GSFC NO.X-650-63-99, NASA/GSFC, MAY 63.*** 4) GOLDBERG,I.:MET IR INSTRUMENTS FOR SATELLITES. NASA/GSFC, AUG. 68. ***5) DATA AVAILABLE FROM NAT SPACE SCIENCE DATA CTR, GSFC.

65. HISTORICAL REMARKS

SIMILAR RADIOMETERS FLOWN ON TIROS 2,3,4,7 AND NIMBUS 2 (MRIR)

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
VIDICON CAMERA SYSTEM	VCSW	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
WIDE-ANGLE LENS	11/10/69	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
RADOS, R.M. (MGR.)	GODDARD SPACE FLT CENTER	301-982-5347
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					POST FLIGHT

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GARBACZ, M.L.	NASA HDQTRS	OSSA/SRO	202-962-4291

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
RCA ASTRO ELECTRONICS	PRINCETON, NEW JERSEY	06/63	NA

26. INSTRUMENT TYPE	27. SECURITY
IMAGER, 0.5-INCH WIDE-ANGLE F/1.5 LOW-RESOLUTION VIDICON	UNC

28. APPLICATION	29. SPACECRAFT
MET	TIROS 7

30. PURPOSE

PRIMARY-TO ACQUIRE AND TRANSMIT PICTURES OF THE EARTH'S CLOUD COVER TO PROVIDE METEOROLOGISTS WITH DETAILED INFORMATION ON INDIVIDUAL CLOUD TYPES OVER SPECIFIC AREAS.***SECONDARY-TO TEST TV SENSOR IN SPACE.

31. PRINCIPLES OF OPERATION

THIS CAMERA SUB-SYSTEM HAS FLOWN IN AN IDENTICAL CONFIGURATION ON TIROS 1-10 AND SIMILAR CONFIGURATION ON ESSA 1, HOWEVER, ON THIS FLIGHT(TIROS 7) 2 WIDE ANGLE CAMERAS WERE USED. IT CONSISTS OF A 1/2 IN VIDICON TUBE AND A POCAL-PLANE SHUTTER THAT PERMITS STORAGE OF STILL PICTURES ON THE TUBE SCREEN. AN ELECTRON BEAM CONVERTS THE STORED PICTURES INTO TELEVISION-TYPE ELECTRONIC SIGNALS,WHICH CAN BE TRANSMITTED TO GROUND RECEIVERS ON COMMAND. THE SYSTEM CAN ALSO PROCESS AND STORE UP TO 32 PICTURES ON MAGNETIC TAPE FOR TRANSMISSION AT A LATER TIME. THE CAMERA HAS A WIDE ANGLE(105 DEG) ELGEET F/1.5 LENS PRODUCING A RESOLUTION OF 1.4 TO 2.0 NM. THE CAMERA HAS A SHUTTER SPEED OF 1.5 MILLSEC AND A VIDEO-BANDWIDTH OF 62.5 KHZ. THE 500 LINE FRAME IS PROCESSED FOR STORAGE IN 2 SECS. A MINIMUM INTERVAL OF 10 SEC BETWEEN PICTURES IS REQUIRED FOR THE TARGET IMAGE TO BE ELECTRICALLY ERASED. THE CAMERA IS ALIGNED PARALLEL TO THE SATELLITES SPIN AXIS AND IS AUTOMATICALLY TRIGGERED SO AS TO BE IN A PICTURE TAKING MODE ONLY WHEN DIRECTED TOWARD THE EARTH. TRANSMISSION OF THE ENTIRE REEL OF 32 PICTURES CAN BE ACCOMPLISHED IN 100 SEC BY A 2-WATT FM TRANSMITTER OPERATING AT A NOMINAL FREQUENCY OF 235 MHZ.

32. PHENOMENA OBSERVED

CLOUD COVER AND THE EARTH'S SURFACE

33. MEASUREMENT RANGE

7 TO 8 LEVELS OF GRAY

34. PRECISION AND ACCURACY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.5 TO 0.65 MICRONS	NA	

38. FIELD OF VIEW	39. GROUND SWATH
74.0 BY 74.0 DEG	750 NM BY 750 NM FROM 475 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.2 DEG	1.5 NM PER TV-LINE FROM 475 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED CIRCULAR MEDIUM	POSIGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

TV CAMERA, TRANSMITTER, TAPE RECORDER

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
7 LB		9 WATTS	NONE	9 WATTS	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
SENSITIVE.				MAGNETIC SHIELDING USED

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
NO IN-FLIGHT CALIBRATION	DELAYED AND REALTIME DAYSIDE OF ORBIT	

62. TELEMETRY REQUIREMENTS

FULL REEL OF 32 PICTURES CAN BE READ OUT IN 100 SECONDS USING AN FM TRANSMITTER OPERATING AT FREQUENCY OF 235 MHZ.

63. ADVANTAGES AND LIMITATIONS

BROAD SYNOPTIC VIEWING OF CLOUD-COVER PATTERNS. MORE VALUABLE DATA FOR WEATHER ANALYSIS THAN FROM MED OR NARROW ANGLE CAMERAS

64. REFERENCES

1) SIGNIFICANT ACHIEVEMENTS IN SAT MET 1958-1964. NASA SP-96.*** 2) GOLDBERG,E.A. AND LANDON, V.D.:KEY EQUIP FOR TIROS 1. ASTRONAUTICS, V.5, JUNE 1960.***3) MESNER,M.H. AND STANISZEWSKI, J.: TV CAMERAS FOR SPACE EXPLOR. ASTRONAUTICS, V.5, MAY 1960.*** 4) INSTRUMENTS AND SPACECRAFT. NASA SP-3028, 1966. ***5) DATA AVAILABLE FROM NATIONAL WEATHER RECORDS CTR (ESSA),ASHEVILLE,NC.

65. HISTORICAL REMARKS

IDENTICAL CAMERA FLOWN ON TIROS 1-10. SIMILAR CAMERA ON ESSA 1.

66. DIAGRAMS

TIROS 8

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
AUTOMATIC PICTURE-TRANSMISSION SYSTEM	APT	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
STAMPFL, DR. R.A.	GODDARD SPACE FLT CENTER	301-982-6163
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					POST FLIGHT

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GARBACZ, M.L.	NASA HDQTRS	OSSA/SRO	202-963-429

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
RCA ASTRO-ELECTRONICS	PRINCETON, N.J.	12/63	NA

26. INSTRUMENT TYPE	27. SECURITY
IMAGER, 1-INCH AUTOMATIC-PICTURE-TRANSMISSION VIDICON	UNC

28. APPLICATION	29. SPACECRAFT
MET	TIROS 8

30. PURPOSE

PRIMARY-TO PROVIDE REAL TIME WIDE-ANGLE CLOUD COVER PICTURES FOR USE BY LOCAL USERS.***SECONDARY-TO CHECKOUT SENSORS TO BE USED IN FUTURE OPERATIONAL TOS FLIGHTS.

31. PRINCIPLES OF OPERATION

THE APT SYSTEM, CONSISTING OF A 1-IN VIDICON ARRANGEMENT, WAS TEST FLOWN ON TIROS 8 AND NIMBUS 1 AND 2 (1 CAMERA), PRIOR TO OPERATIONAL TOS FLIGHTS: ESSA 2,4,6, AND TIROS M (2 CAMERAS). THE VIDICON USED INITIALLY (TIROS 8 AND NIMBUS 1), HAD A DIELECTRIC LAYER DEPOSITED ON THE GUN SIDE OF THE PHOTOCONDUCTOR TO STORE THE SCENE INFORMATION. HOWEVER, SINCE THE ELECTRON BEAM ALTERED THE ELECTRIC PROPERTIES OF THIS SURFACE, THE VIDICON WAS UPGRADED FOR FUTURE FLIGHTS. THE CAMERA UTILIZES A TEGEA-KINOPTIC, 108-DEG, WIDE-ANGLE, F/1.8 OBJECTIVE LENS WITH A 5.7 MM FL. THE SYSTEM AUTOMATICALLY TAKES AND TRANSMITS A PICTURE EVERY 208 SECS WHILE THE SATELLITE IS IN DAYLIGHT. OPTICAL EXPOSURE TIME IS 40 MILLISEC, GIVING SMEAR OF LESS THAN 10 PERCENT OF ONE PICTURE ELEMENT. AN 8-SECOND TURN-ON AND SYNC SIGNAL PRECEDES THE 200-SECOND TRANSMISSION, AT WHICH TIME THE VIDICON IS SCANNED AT 4 LINES PER SEC, PRODUCING AN 800-LINE PICTURE WITH SCAN LINES PERPENDICULAR TO THE ORBIT TRACK. A 5-WATT TV TRANSMITTER BROADCASTS THE SIGNAL IN THE 136.95 MHZ BAND. AN APT GROUND STATION WITH AN APPROPRIATE ANTENNA, RECEIVER, AND A RECORDER CAN RECEIVE THESE PICTURES WHEN THE SPACECRAFT IS WITHIN ACQUISITION RANGE. APT IS COMPATIBLE WITH COMMERCIAL 240 RPM FAX EQUIPMENT.

32. PHENOMENA OBSERVED

CLOUD AND TERRAIN FEATURES APPROXIMATELY 1.7 NM OR LARGER

33. MEASUREMENT RANGE

DYNAMIC PICTURE RANGE OF 10:1

34. PRECISION AND ACCURACY

6 TO 10 LEVELS OF BRIGHTNESS VARIATION

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.45 TO 0.65 MICRON	NA	

38. FIELD OF VIEW	39. GROUND SWATH
89.0 BY 89.0 DEG	1200 NM BY 1200 NM FROM 450 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.16 DEG	1.7 NM FROM 450 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
1.0 DEG	0.1 DEG/SEC	MED CIRCULAR	MEDIUM POSIGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

VIDICON, ELECTRONICS, TRANSMITTER, TAPE RECORDER

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
24 LB				40 WATTS	200 HRS

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
SENSITIVE	SENSITIVE			MAGNETIC SHIELDING USED

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
FIDUCIAL MARKS INCLUDED	REALTIME TELEMETRY	CONTINUOUS DAYTIME

62. TELEMETRY REQUIREMENTS

PICTURE IS COMMUNICATED TO AN EARTH STATION IN THE SPACE RESEARCH BAND OF 136-137 MHZ. THE VIDEO OUTPUT REQUIRES 4 KHZ MAXIMUM BANDWIDTH CAPABILITY.

63. ADVANTAGES AND LIMITATIONS

DIRECT TRANSMISSION ON COMMAND TO MANY RECEIVERS WITHOUT INTERMEDIATE STORAGE. DIELECTRIC SURFACE OF VIDICON LIMITED TUBELIFE.

64. REFERENCES

1) SIG ACHIEV IN SAT MET 1958-1964. NASA SP-96.***2) STAMPFL, R. A. AND STROUD, W.G.: THE APT TV CAMERA SYSTEM FOR MET SATS, JOUR SMPTE, VOL 73, FEB 1969.***3) OSTROW, H. AND WEINSTEIN, O.: REVIEW OF A DECADE OF SPACE CAMERA SYSTEMS DEVELOPMENT FOR METEOROLOGY. PRESENTED AT 13TH ANNUAL TECH SYMP OF THE SOCIETY OF PHOTO-OPTICAL INSTRUMENTATION ENGINEERS, AUG. 19-23, 1968.

65. HISTORICAL REMARKS

SIMILAR TO APT ON NIMBUS 1 AND 2, ESSA 2,4,6; SCHED FOR TIROS M

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
VIDICON CAMERA SYSTEM	VCSW	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
WIDE-ANGLE LENS	11/10/69	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
RADOS, R.M. (MGR.)	GODDARD SPACE FLT CENTER	301-982-5347
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					POST FLIGHT

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GARBACZ, M.L.	NASA HDQTRS	OSSA/SRO	202-963-4291

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
RCA ASTRO-ELECTRONICS	PRINCETON, N. J.	12/63	NA

26. INSTRUMENT TYPE	27. SECURITY
IMAGER, WIDE-ANGLE F/1.5 LOW-RESOLUTION 0.5-INCH VIDICON	UNC

28. APPLICATION	29. SPACECRAFT
MET	TIROS 8

30. PURPOSE

PRIMARY-TO ACQUIRE AND TRANSMIT PICTURES OF THE EARTH'S CLOUD COVER TO PROVIDE METEOROLOGISTS WITH DETAILED INFORMATION ON INDIVIDUAL CLOUD TYPES OVER SPECIFIC AREAS.***SECONDARY-TO TEST TV SENSOR IN SPACE.

31. PRINCIPLES OF OPERATION

THIS CAMERA SUB-SYSTEM HAS FLOWN IN AN IDENTICAL CONFIGURATION ON TIROS 1-10 AND SIMILAR CONFIGURATION ON ESSA 1. ON TIROS 1-8, 10 THE CAMERAS WERE ALIGNED PARALLEL TO THE S/C SPIN AXIS AND EXTENDED THROUGH THE BASE PLATE. IT CONSISTS OF A 1/2-IN VIDICON TUBE AND A FOCAL-PLANE SHUTTER THAT PERMITS STORAGE OF STILL PICTURES ON THE TUBE SCREEN.AN ELECTRON BEAM CONVERTS THE STORED PICTURES INTO TELEVISION-TYPE ELECTRONIC SIGNALS, WHICH CAN BE TRANSMITTED TO GROUND RECEIVERS ON COMMAND.THE SYSTEM CAN ALSO PROCESS AND STORE UP TO 32 PICTURES ON MAGNETIC TAPE FOR TRANSMISSION AT A LATER TIME. THE CAMERA HAS A WIDE-ANGLE (105 DEG) ELGEET F/1.5 LENS PRODUCING A RESOLUTION OF 1.4 TO 2.0 NM. THE CAMERA HAS A SHUTTER SPEED OF 1.5 MILLISEC AND A VIDEO-BANDWIDTH OF 62.5 KHZ. THE 500 LINE FRAME IS PROCESSED FOR STORAGE IN 2 SEC. A MINIMUM INTERVAL OF 10 SEC BETWEEN PICTURES IS REQUIRED FOR THE TARGET IMAGE TO BE ELECTRICALLY ERASED. THE CAMERA IS ALIGNED PARALLEL TO THE SATELLITES SPIN AXIS AND IS AUTOMATICALLY TRIGGERED SO AS TO BE IN A PICTURE TAKING MODE ONLY WHEN DIRECTED TOWARD THE EARTH. TRANSMISSION OF THE ENTIRE REEL OF 32 PICTURES CAN BE ACCOMPLISHED IN 100 SEC BY A 2-WATT FM TRANSMITTER OPERATING AT A NOMINAL FREQUENCY OF 235 MHZ.

32. PHENOMENA OBSERVED

CLOUD COVER AND THE EARTH'S SURFACE

33. MEASUREMENT RANGE

7 TO 8 LEVELS OF GRAY

34. PRECISION AND ACCURACY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.5 TO 0.65 MICRONS	NA	

38. FIELD OF VIEW	39. GROUND SWATH
74.0 BY 74.0 DEG	725 NM BY 725 NM FROM 450 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.2 DEG	1.4 NM PER TV-LINE FROM 450 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED CIRCULAR	MEDIUM POSIGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

TV CAMERA, TRANSMITTER, TAPE RECORDER

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
7 LB		9 WATTS	NONE	9 WATTS	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
	SENSITIVE			MAGNETIC SHIELDING USED

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
NO IN-FLIGHT CALIBRATION	DELAYED AND REALTIME	DAYSIDE OF ORBIT

62. TELEMETRY REQUIREMENTS

FULL REEL OF 32 PICTURES CAN BE READ OUT IN 100 SECONDS USING AN FM TRANSMITTER OPERATING AT FREQUENCY OF 235 MHZ.

63. ADVANTAGES AND LIMITATIONS

BROAD SYNOPTIC VIEWING OF CLOUD COVER PATTERNS. MORE VALUABLE DATA FOR WEATHER ANALYSIS THAN FROM MED OR NARROW ANGLE CAMERAS

64. REFERENCES

1) SIGNIFICANT ACHIEVEMENTS IN SAT MET 1958-1964. NASA SP-96.***
2) GOLDBERG, E.A. AND LANDON, V.D.:KEY EQUIP FOR TIROS 1. ASTRONAUTICS, V.5, JUNE 1960.***3) MESNER,M.H. AND STANISZEWSKI, J.: TV CAMERAS FOR SPACE EXPLOR. ASTRONAUTICS, V.5, MAY 1960.***
4) INSTRUMENTS AND SPACECRAFT. NASA SP-3028, 1966. ***5) DATA AVAILABLE FROM NATIONAL WEATHER RECORDS CTR (ESSA),ASHEVILLE,NC.

65. HISTORICAL REMARKS

IDENTICAL CAMERA FLOWN ON TIROS 1-10. SIMILAR CAMERA ON ESSA 1.

66. DIAGRAMS

TIROS 9

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
VIDICON CAMERA SYSTEM	VCSW	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
WIDE-ANGLE LENS	11/10/69	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
RADOS, R. M. (MGR.)	GODDARD SPACE FLT CENTER	301-982-5347
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					POST FLIGHT

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GARBACZ, M.L.	NASA HDQTRS	OSSA/SRO	202-963-429

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
RCA ASTRO-ELECTRONICS	PRINCETON, N. J.	01/65	NA

26. INSTRUMENT TYPE	27. SECURITY
IMAGER, WIDE-ANGLE F/1.5 LOW-RESOLUTION 0.5-INCH VIDICON	UNC

28. APPLICATION	29. SPACECRAFT
MET	TIROS 9

30. PURPOSE

PRIMARY-TO ACQUIRE AND TRANSMIT PICTURES OF THE EARTH'S CLOUD COVER TO PROVIDE METEOROLOGISTS WITH DETAILED INFORMATION ON INDIVIDUAL CLOUD TYPES OVER SPECIFIC AREAS.***SECONDARY-TO TEST TV SENSOR IN SPACE.

31. PRINCIPLES OF OPERATION

THE TIROS 9 WIDE ANGLE TV CAMERA WAS IDENTICAL TO THOSE CARRIED ON ALL TIROS MISSIONS AND ESSA 1. HOWEVER, THIS FLIGHT CARRIED 2, IN A NEW CONFIGURATION(CARTWHEEL), MOUNTED ON THE SIDE OF THE SPACECRAFT AND CANTED 26 DEG TO EACH SIDE OF THE PLANE OF THE SATELLITE'S ROTATION(10RPM). EACH CAMERA WAS AUTOMATICALLY TRIGGERED SO AS TO BE IN A PICTURE TAKING MODE ONLY WHEN VIEWING THE EARTH(ONCE EACH ORBIT). EACH CAMERA CONSISTS OF A 1/2-INCH VIDICON TUBE AND A FOCAL-PLANE SHUTTER THAT PERMITS STORAGE OF STILL PICTURES ON THE TUBE SCREEN. AN ELECTRON BEAM CONVERTS THE STORED PICTURES INTO TV-TYPE ELECTRONIC SIGNALS, WHICH CAN BE TRANSMITTED TO GROUND RECEIVERS ON COMMAND. THE SYSTEM CAN ALSO PROCESS AND STORE UP TO 48 PICTURES ON MAGNETIC TAPE FOR LATER TRANSMISSION. THE CAMERA HAS A WIDE-ANGLE (105 DEG) ELGEET F/1.5 LENS. THE CAMERA HAS A SHUTTER SPEED OF 1.5 MILLISEC AND A VIDEO BANDWIDTH OF 62.5 KHZ. THE 500 LINE FRAME IS PROCESSED FOR STORAGE IN 2 SECS. A MINIMUM INTERVAL OF 10 SEC BETWEEN PICTURES IS REQUIRED FOR THE TARGET IMAGE TO BE ELECTRICALLY ERASED. TRANSMISSION OF THE ENTIRE REEL OF 48 PICTURES CAN BE ACCOMPLISHED IN 120 SECONDS USING A 5-WATT FM TRANSMITTER OPERATING AT A NOMINAL FREQUENCY OF 235 MHZ.

32. PHENOMENA OBSERVED

CLOUD COVER AND THE EARTH'S SURFACE

33. MEASUREMENT RANGE

7 TO 8 LEVELS OF GRAY

34. PRECISION AND ACCURACY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.5 TO 0.65 MICRONS	NA	

38. FIELD OF VIEW	39. GROUND SWATH
74.0 BY 74.0 DEG	750 NM BY 750 NM FROM 500 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.2 DEG	1.5 NM PER TV LINE FROM 500 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED ECCENTRIC	MEDIUM POSIGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

TV CAMERA, TRANSMITTER, TAPE RECORDER

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
7 LB		9 WATTS	NONE	9 WATTS	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
SENSITIVE				MAGNETIC SHIELDING USED

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
NO IN-FLIGHT CALIBRATION	DELAYED AND REALTIME	DAYSIDE OF ORBIT

62. TELEMETRY REQUIREMENTS

FULL REEL OF 48 PICTURES CAN BE READ OUT IN 120 SECONDS USING AN FM TRANSMITTER OPERATING AT FREQUENCY OF 235 MHZ.

63. ADVANTAGES AND LIMITATIONS

BROAD SYNOPTIC VIEWING OF CLOUD COVER PATTERNS. MORE VALUABLE DATA FOR WEATHER ANALYSIS THAN FROM MED OR NARROW ANGLE CAMERAS

64. REFERENCES

1) SIGNIFICANT ACHIEVEMENTS IN SAT MET 1958-1964. NASA SP-96.*** 2) GOLDBERG, E.A. AND LANDON, V.D.: KEY EQUIP FOR TIROS 1. ASTRONAUTICS, V.5, JUNE 1960.***3) MESNER, M.H. AND STANISZEWSKI, J.: TV CAMERAS FOR SPACE EXPLOR. ASTRONAUTICS, V.5, MAY 1960.*** 4) INSTRUMENTS AND SPACECRAFT. NASA SP-3028, 1966. ***5) DATA AVAILABLE FROM NATIONAL WEATHER RECORDS CTR (ESSA), ASHEVILLE, NC.

65. HISTORICAL REMARKS

BASIC CAMERA IDENTICAL TO THOSE FLOWN ON TIROS 1-10 AND ESSA 1.

66. DIAGRAMS

TIROS 10

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
VIDICON CAMERA SYSTEM	VCSW	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
WIDE-ANGLE LENS	11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
RADOS, R.M. (MGR.)	GODDARD SPACE FLT CENTER	301-982-5347
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					POST FLIGHT

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GARBACZ, M.L.	NASA HDQTRS	OSSA/SRO	202-963-429

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
RCA ASTRO ELECTRONICS	PRINCETON, N. J.	07/65	NA

26. INSTRUMENT TYPE	27. SECURITY
IMAGER, WIDE-ANGLE F/1.5 LOW-RESOLUTION 0.5-INCH VIDICON	UNC

28. APPLICATION	29. SPACECRAFT
MET	TIROS 10

30. PURPOSE

PRIMARY-TO ACQUIRE AND TRANSMIT PICTURES OF THE EARTH'S CLOUD COVER TO PROVIDE METEOROLOGISTS WITH DETAILED INFORMATION ON INDIVIDUAL CLOUD TYPES OVER SPECIFIC AREAS.***SECONDARY-TO TEST TV SENSOR IN SPACE.

31. PRINCIPLES OF OPERATION

THIS CAMERA SUB-SYSTEM HAS FLOWN IN AN IDENTICAL CONFIGURATION ON TIROS 1-10 AND SIMILAR CONFIGURATION ON ESSA 1, HOWEVER, ON THIS FLIGHT, TWO WIDE-ANGLE CAMERAS WERE USED. EACH CONSISTS OF A 0.5-IN VIDICON TUBE AND A FOCAL-PLANE SHUTTER THAT PERMITS STORAGE OF STILL PICTURES ON THE TUBE SCREEN. AN ELECTRON BEAM CONVERTS THE STORED PICTURES INTO TELEVISION-TYPE ELECTRONIC SIGNALS, WHICH CAN BE TRANSMITTED TO GROUND RECEIVERS ON DEMAND. THE SYSTEM CAN ALSO PROCESS AND STORE UP TO 32 PICTURES ON MAGNETIC TAPE FOR TRANSMISSION AT A LATER TIME. THE CAMERA HAS A WIDE-ANGLE (105 DEG) ELGEET F/1.5 LENS PRODUCING A RESOLUTION OF 1.4 TO 2.0 NM. THE CAMERA HAS A SHUTTER SPEED OF 1.5 MILLISEC AND A VIDEO-BANDWIDTH OF 62.5 KHZ. THE 500 LINE FRAME IS PROCESSED FOR STORAGE IN 2 SECS. A MINIMUM INTERVAL OF 10 SEC BETWEEN PICTURES IS REQUIRED FOR THE TARGET IMAGE TO BE ELECTRICALLY ERASED. THE CAMERA IS ALIGNED PARALLEL TO THE SATELLITES SPIN AXIS AND IS AUTOMATICALLY TRIGGERED SO AS TO BE IN A PICTURE TAKING MODE ONLY WHEN DIRECTED TOWARD THE EARTH. TRANSMISSION OF THE ENTIRE REEL OF 32 PICTURES CAN BE ACCOMPLISHED IN 100 SEC BY A 2-WATT FM TRANSMITTER OPERATING AT A NOMINAL FREQUENCY OF 235 MHZ.

32. PHENOMENA OBSERVED

CLOUD COVER AND THE EARTH'S SURFACE

33. MEASUREMENT RANGE

7 TO 8 LEVELS OF GRAY

34. PRECISION AND ACCURACY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.5 TO 0.65 MICRONS	NA	

38. FIELD OF VIEW	39. GROUND SWATH
74.0 BY 74.0 DEG	725 NM BY 725 NM FROM 450 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.2 DEG	1.4 NM PER TV-LINE FROM 450 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED CIRCULAR	MEDIUM POSIGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

TV CAMERA, TRANSMITTER, TAPE RECORDER

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
7 LB		9 WATTS	NONE	9 WATTS	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
SENSITIVE				MAGNETIC SHIELDING USED

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
NO IN-FLIGHT CALIBRATION	DELAYED AND REALTIME	DAYSIDE OF ORBIT

62. TELEMETRY REQUIREMENTS

FULL FEEL OF 32 PICTURES CAN BE READ OUT IN 100 SECONDS USING AN FM TRANSMITTER OPERATING AT FREQUENCY OF 235 MHZ.

63. ADVANTAGES AND LIMITATIONS

BROAD SYNOPTIC VIEWING OF CLOUD COVER PATTERNS. MORE VALUABLE DATA FOR WEATHER ANALYSIS THAN FROM MED OR NARROW ANGLE CAMERAS

64. REFERENCES

1) SIGNIFICANT ACHIEVEMENTS IN SAT MET 1958-1964. NASA SP-96.*** 2) GOLDBERG, E.A. AND LANDON, V.D.: KEY EQUIP FOR TIROS 1. ASTRONAUTICS, V.5, JUNE 1960.***3) MESNER, M.H. AND STANISZEWSKI, J.: TV CAMERAS FOR SPACE EXPLOR. ASTRONAUTICS, V.5, MAY 1960.*** 4) INSTRUMENTS AND SPACECRAFT. NASA SP-3028, 1966. ***5) DATA AVAILABLE FROM NATIONAL WEATHER RECORDS CTR (ESSA), ASHEVILLE, NC.

65. HISTORICAL REMARKS

IDENTICAL CAMERA FLOWN ON TIROS 1-10. SIMILAR CAMERA ON ESSA 1.

66. DIAGRAMS

TIROS M

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
ADVANCED VIDICON CAMERA SYSTEM	AVCS	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
OBRIEN, J.(TECH MON)	GODDARD SPACE FLT CENTER	301-982-5348
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					INTEGRATION

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GARBACZ, M.L.	NASA HDQTRS	OSSA/SRO	202-963-4291

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
RCA ASTRO-ELECTRONICS	PRINCETON, N.J.		NA

26. INSTRUMENT TYPE	27. SECURITY
IMAGER, HIGH-RESOLUTION WIDE-ANGLE 1-INCH VIDICON CAMERA	UNC

28. APPLICATION	29. SPACECRAFT
MET, ERSP	TIROS M

30. PURPOSE

PRIMARY-TO PROVIDE METEOROLOGICAL DATA IN THE FORM OF WIDE-ANGLE HIGH-RESOLUTION TELEVISION PICTURES OF EARTH'S CLOUD COVER.*** SECONDARY-TO MAINTAIN OPERATIONAL CAPABILITY OF THE AVCS.

31. PRINCIPLES OF OPERATION

THE AVCS FOR TIROS M IS BASICALLY SIMILAR TO THE SYSTEMS TEST FLOWN ON NIMBUS 1 AND 2 AND OPERATIONALLY FLOWN ON ESSA 3 AND 5. THE TIROS M SYSTEM CONSISTS OF 2 IDENTICAL 1-IN VIDICONS HAVING 833 TV LINE RESOLUTION WITH ONLY 1 IN OPERATION AT ANY GIVEN TIME. THE CAMERAS ARE MOUNTED ON THE BASEPLATE OF THE SPACECRAFT AND LOOK AT THE NADIR DURING PICTURE-TAKING SEQUENCES. THE LENS IS A TEGEA-KINOPTIC, 108 DEG, WIDE-ANGLE, F/1.8, 5.7 MM LENS USING AN ELECTROMAGNETICALLY CONTROLLED SHUTTER. THE VIDICON IS A "HYBRID VIDICON" WHICH IS ELECTROSTATICALLY FOCUSED AND MAGNETICALLY DEFLECTED. IT HAS AN INHERENT STORAGE PROPERTY WHICH PERMITS A NOMINAL 6.5 SEC FRAME SCAN TIME. A GRAY-SCALE CALIBRATOR ASSEMBLY, UTILIZING AN INCANDESCENT LAMP AS A LIGHT SOURCE, PROVIDES 15 LINEAR DENSITY STEPS. THE LIGHT OUTPUT IS DIRECTED THROUGH THE GRAY-SCALE TRANSPARENCY BY MEANS OF A LENS AND PRISM ARRANGEMENT AND IMPRESSED ON THE VIDICON PHOTO CONDUCTOR. THE GRAY-SCALE SERVES AS A REFERENCE WHEN THE TV PICTURES ARE PROCESSED ON THE GROUND. A COMPLETE PICTURE SEQUENCE LASTS ABOUT 48 MIN, DURING WHICH 11 PICTURES ARE TAKEN AT INTERVALS OF 260 SEC (GIVING AN OVERLAP OF 50 PERCENT) AND STORED IN A 3-CHANNEL TAPE RECORDER FOR LATER TRANSMISSION.

32. PHENOMENA OBSERVED

CLOUD COVER OF EARTH (REFLECTED VISIBLE SOLAR RADIATION)

33. MEASUREMENT RANGE

DYNAMIC RANGE OF 200 TO 10,000 FOOT-LAMBERTS

34. PRECISION AND ACCURACY

833-LINE RESOLUTION, 15-16 LEVELS OF GRAY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.4 TO 0.65 MICRON	NA	

38. FIELD OF VIEW	39. GROUND SWATH
89.0 BY 89.0 DEG	1700 NM BY 1700 NM FROM 750 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.13 DEG	1.7 NM PER TV-LINE AT THE CENTER FROM 750 NM ALT

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
NA		MED CIRCULAR	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

2 TV CAMERAS, 2 TAPE RECORDERS, SYSTEM ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
63 LB		NA			

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
	SENSITIVE			MAGNETIC SHIELDING USED

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
GRAY-SCALE CALIBRATION	DELAYED AND REALTIME	DAYSIDE OF ORBIT

62. TELEMETRY REQUIREMENTS

THE AVCS VIDEO SIGNAL HAS A BASEBAND OF 60 KHZ, WITH ITS DATA MADE UP OF DISCRETE FRAMES.

63. ADVANTAGES AND LIMITATIONS

64. REFERENCES

1) DESIGN STUDY REPORT FOR THE IMPROVED TOS (ITOS) SYSTEM, V.1-3, RCA ASTRO-ELECTRONICS, CONTRACT NO. NAS5-9034, JUN 7,68.***2) FINAL ENGINEERING REPORT TOS A, VOL 1,2,3. RCA ASTRO-ELECTRONICS DIV. CONTRACT NO. NAS5-9034, MAY 5,1967.***3) ESSA PRESS RELEASE FOR ESSA 3, ES 66054, SEPT. 19, 1966.***4) SIG. ACHIEV. IN SPACE APP. 1966, NASA SP-156, 1967.

65. HISTORICAL REMARKS

SIMILAR TO AVCS ON NIMBUS 1 AND 2, AND ESSA 3 AND 5.

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
AUTOMATIC PICTURE-TRANSMISSION SYSTEM	APT	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
OBRIEN,J.(TECH MON)	GODDARD SPACE FLT CENTER	301-982-5348
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					INTEGRATION

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GARBACZ, M.L.	NASA HDQTRS	OSSA/SRO	202-963-429

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
RCA ASTRO-ELECTRONICS	PRINCETON, N.J.		NA

26. INSTRUMENT TYPE	27. SECURITY
IMAGER, 1-INCH AUTOMATIC-PICTURE-TRANSMISSION VIDICON	UNC

28. APPLICATION	29. SPACECRAFT
MET	TIROS M

30. PURPOSE

PRIMARY-TO PROVIDE METEOROLOGISTS WITH DAYTIME OBSERVATIONS OF CLOUD COVER AS DETECTED IN THE VISIBLE SPECTRUM FOR DIRECT TRANSMISSION TO USERS LOCATED AROUND THE WORLD.***SECONDARY-TO EXPAND THE OPERATIONAL CAPABILITY OF THE BASIC TOS SYSTEM.

31. PRINCIPLES OF OPERATION

THE APT CAMERA SUBSYSTEM HAS ALSO BEEN FLOWN PREVIOUSLY ON TIROS 8, NIMBUS 1,2,AND ESSA 2,4,6 IN SIMILAR CONFIGURATION. THE TIROS M SUBSYSTEM WILL CONSIST OF 2 IDENTICAL 1-INCH VIDICON APT CAMERAS,EACH UTILIZING A TEGRA-KINOPTIC, 108-DEG, WIDE-ANGLE, F/1.8 OBJECTIVE LENS WITH A FOCAL LENGTH OF 5.7 MM. ONLY ONE CAMERA IS UTILIZED FOR OPERATION DURING ANY PICTURE-TAKING SEQUENCE. THE APT SUBSYSTEM IS CONTROLLED BY GROUND-INITIATED COMMANDS THAT ARE TRANSMITTED TO AND STORED BY THE SATELLITE.ONCE THE SEQUENCE IS INITIATED, THE CAMERA WILL TAKE A PICTURE ONCE EVERY 260 SEC UNTIL THE PRESCRIBED 11 PICTURES HAVE BEEN TAKEN. THE ACTUAL PICTURE TAKING REQUIRES 8 SEC WITH AN EXPOSURE TIME OF 25 MILLI-SEC, AND THE TRANSMISSION 150.SECS. DURING THIS LATTER PERIOD THE VIDICON IS SCANNED AT 4 LINES PER SEC, AND THE SIGNALS TRANSMITTED PRODUCING AN 600-LINE PICTURE WITH SCAN LINES PERPENDICULAR TO THE ORBIT TRACK. TWO 5-WATT TV TRANSMITTERS ARE USED, EACH PROVIDING A 137.62 MHZ CARRIER. AN APT GROUND STATION WITH AN APPROPRIATE ANTENNA, RECEIVER, AND A RECORDER CAN RECEIVE THESE PICTURES WHEN THE SPACECRAFT IS WITHIN ACQUISITION RANGE.

32. PHENOMENA OBSERVED

CLOUD AND TERRAIN FEATURES OF APPROX 3.4 NM OR LARGER

33. MEASUREMENT RANGE

DYNAMIC PICTURE RANGE OF 20:1

34. PRECISION AND ACCURACY

S/N OF 32 DB, MINIMUM; 8 GRAY LEVELS CAN BE RESOLVED

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.45 TO 0.65 MICRON	NA	

38. FIELD OF VIEW	39. GROUND SWATH
89.0 BY 89.0 DEG	1700 NM BY 1700 NM FROM 750 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.25 DEG	3.4 NM PER TV-LINE AT CENTER FROM 750 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED CIRCULAR	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

CAMERAS (2), ELECTRONICS (2)

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
45 LB					

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
SENSITIVE	SENSITIVE			

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
	REALTIME TELEMETRY	DAYTIME ON COMMAND

62. TELEMETRY REQUIREMENTS

THE VIDEO OUTPUT, TURN-ON, AND PHASING CODE DRIVE A MODULATOR WHOSE AMPLITUDE MODULATES THE 2400 HZ SUBCARRIER, WHICH IN TURN MODULATES THE 137.62 MHZ CARRIER.

63. ADVANTAGES AND LIMITATIONS

AN IMPROVED DOUBLE-BLADED,SOLENOID-ACTUATED SHUTTER WILL BE USED ON THIS APT. REVISED TIMING TO PROVIDE 11 PICTURES FROM 1 CAMERA

64. REFERENCES

1) DESIGN STUDY REPORT FOR THE IMPROVED TOS(ITOS) SYSTEM,VOL.1,2. RCA ASTRO-ELECTRONICS CONTRACT NO. NAS 5-9032. JUNE 7,68.***2) APT USER'S GUIDE. ESSA, NAT WEATHER SAT CTR, 1965.***3) STAMPFL, R.A. AND STROUD, W.G.: THE APT TV CAMERA SYSTEM FOR MET SATS, NASA TN D-1915, NOV. 1963.***4) FINAL ENGINEERING REPORT, TOS/OT-2. RCA CORP., MAY, 1967.

65. HISTORICAL REMARKS

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
FLAT-PLATE RADIOMETER	FPR	
(TITLE CONT.)	4. RESUME DATE: 11/10/69	5. VERSION: 0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
PARENT, DR. R.J.	UNIVERSITY OF WISCONSIN	608-262-0724
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					INTEGRATION

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GARBACZ, M.L.	NASA HDQTRS	OSSA/SRO	202-963-4291

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
UNIVERSITY OF WISCONSIN	MADISON, WISCONSIN		NA

26. INSTRUMENT TYPE	27. SECURITY
RADIOMETER, FOUR IR/VISIBLE LOW-RESOLUTION THERMISTOR	UNC

28. APPLICATION	29. SPACECRAFT
MET	TIROS M

30. PURPOSE

PRIMARY-TO GATHER DATA TO AID IN DETERMINING: (1) THE GEOGRAPHIC DISTRIBUTION OF ENERGY RADIATED FROM THE EARTH AND THE RELATIONSHIP OF THIS ENERGY TO INCOMING ENERGY FROM THE SUN AND (2) THE REFLECTION AND SCATTERING OF SOLAR RADIATION BY THE EARTH-ATMOSPHERE SYSTEM.

31. PRINCIPLES OF OPERATION

THE ITOS FLAT PLATE RADIOMETER (FPR), WILL ALSO BE FLOWN ON ITOS A, B, C, AND D. THE PRINCIPAL PART OF EACH RADIOMETER IS A THIN ALUMINUM DISK, THE TEMPERATURE OF WHICH IS SENSED BY THERMISTORS MOUNTED ON THE BACK SURFACE. THE HOUSING TEMPERATURES ARE SEPARATELY SENSED AND RECORDED. THERE ARE 2 PAIRS OF SENSORS. ONE DISK OF EACH PAIR IS PAINTED BLACK AND ONE IS ANODIZED ALUMINUM. THE BLACK PAINTED SURFACE WILL RESPOND TO THE SUM OF THE REFLECTED SOLAR, DIRECT SOLAR, AND RERADIATED LONG-WAVE RADIATION. THE ANODIZED ALUMINUM (WHITE) DISKS REFLECT IN THE VISIBLE RANGE BUT ARE BLACK TO IR BEYOND 7 MICRONS. THESE ABSORB THE RERADIATED ENERGY FROM THE EARTH AND EXCLUDE TO A HIGH DEGREE THE DIRECT AND REFLECTED SOLAR RADIATION. ONE BLACK/WHITE PAIR WILL OPERATE AS RADIATIVE EQUILIBRIUM DETECTORS, SIMILAR TO ESSA. THE 2ND PAIR IS OF A NEW THERMAL FEEDBACK DESIGN. THE ENERGY REQUIRED TO MAINTAIN A CONSTANT TEMPERATURE WILL BE MEASURED. THE SET OF 4 RADIOMETERS ARE MOUNTED BETWEEN THE 2 SCANNING RADIOMETERS AND POINT TO THE NADIR. THE FIELD OF VIEW IS 180 DEGREES FOR ALL FOUR SENSORS.

32. PHENOMENA OBSERVED

ENERGY RADIATED FROM AND REFLECTED BY THE EARTH-ATMOSPHERE

33. MEASUREMENT RANGE

34. PRECISION AND ACCURACY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.3 TO 30.0 MICRON		

38. FIELD OF VIEW	39. GROUND SWATH
SEE ITEM 31	LIMB-TO-LIMB (3700 NM) FROM 500 NM ALT

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED CIRCULAR	SUN SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

4 SENSORS (THERMISTORS), ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
		SENSITIVE	SENSITIVE	FPR THERMALLY ISOLATED

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
VIEW OF HOUSING	DELAYED TELEMETRY	CONTINUOUS

62. TELEMETRY REQUIREMENTS

15 WORDS CONSTITUTE ONE FPR FRAME OF DATA, 8 BITS TO THE WORD. THE FRAME IS READ OUT SERIALLY AT 15 BPS TAKING 8 SECONDS. DATA SAMPLING CYCLE TAKES 32 SECONDS.

63. ADVANTAGES AND LIMITATIONS

64. REFERENCES

1) DESIGN STUDY REPORT FOR THE IMPROVED TOS (ITOS) SYSTEM, V.1,2. RCA ASTRO-ELECTRONICS, CONTRACT NO. NAS5-9034, JUNE 7, 1968.***
2) RUBIN, L.: OPERATIONAL PROCESSING OF LOW RESOLUTION IR (LRIR) DATA FROM ESSA SATELLITES. ESSA TECH REPORT NESC-42, FEB. 1968.

65. HISTORICAL REMARKS

THIS FPR IS SIMILAR TO THOSE FLOWN ON ESSA 3, 5, 7, AND 9.

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
SCANNING RADIOMETER	SR	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
GEMUNDER, G. (T MON)	GODDARD SPACE FLT CENTER	301-986-5716
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					INTEGRATION

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GARBACZ, M.L.	NASA HDQTRS	OSSA/SRO	202-963-4291

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
SANTA BARBARA RES CENTER	GOLETA, CALIF		NA

26. INSTRUMENT TYPE	27. SECURITY
RADIOMETER, VISIBLE/IR SCANNING	UNC

28. APPLICATION	29. SPACECRAFT
MET, ATM-PHYS, PART-FLD	TIROS M

30. PURPOSE

PRIMARY-TO MEASURE EMITTED RADIATION FROM THE EARTH DURING DAY AND NIGHT AND TO MEASURE REFLECTED RADIATION FROM THE EARTH DURING DAYTIME. THE SYSTEM PERMITS DETERMINATION OF THE SURFACE TEMPERATURE OF THE GROUND, SEA, OR CLOUD TOPS THAT ARE VIEWED BY THE RADIOMETER.

31. PRINCIPLES OF OPERATION

THIS SCANNING RADIOMETER SYSTEM CONSISTS OF 2 REDUNDANT RADIOMETERS WITH SUPPORTING COMPONENTS. EACH HAS 2 DATA CHANNELS: AN IR (10.5-12.5 MICRONS) AND VISIBLE (0.52-0.73 MICRON) BOTH WITH AN INSTANTANEOUS FOV OF 0.3 DEG. THE RADIOMETER SCANS THE EARTH'S SURFACE FROM HORIZON TO HORIZON, PERPENDICULAR TO THE ORBITAL PLANE BY MEANS OF A CONTINUOUSLY ROTATING MIRROR(48 RPM) WHICH IS INCLINED 45 DEG TO ITS AXIS OF ROTATION. THE IR CHANNEL IS CALIBRATED AT THE COLD EXTREME BY MEASURING THE RESPONSE TO OUTER SPACE AND ON THE WARM SIDE BY MEASURING THE IR RADIATION FROM INSIDE THE RADIOMETER HOUSING. THE VISIBLE CHANNEL IS CALIBRATED SEPARATELY. IN OPERATION, RADIATION REFLECTS FROM THE ROTATING MIRROR TO THE COLLECTING OPTICS, A 5-IN DIAM CASSEGRAINIAN SYSTEM, AND IS THEN FOCUSED ONTO THE BEAM SPLITTER (DICHROIC MIRROR). THE IR PASSES THROUGH AND IS MEASURED BY A SOLID-STATE RADIANT ENERGY DETECTOR (THERMISTOR BOLOMETER). THE VISIBLE IS REFLECTED FROM THE BEAM SPLITTER AND PASSES THROUGH A 0.52-0.73 MICRON WAVELENGTH FILTER ONTO A PHOTOVOLTAIC SILICON DETECTOR. DATA ARE RECORDED ON TAPE. THE IR CHANNEL ALSO IS COMPATIBLE WITH THE APT SYSTEM PRODUCING A DIRECT READOUT IR SYSTEM.

32. PHENOMENA OBSERVED

ENERGY IN THE INFRARED AND VISIBLE REGION OF THE SPECTRUM

33. MEASUREMENT RANGE

VISIBLE BRIGHTNESS: 20-8500 FT-LAMBERT; IR TEMP: 185-330 DEG K

34. PRECISION AND ACCURACY

1.0 K DEG AT 300 DEG K; 4.0 K DEG AT 185 DEG K

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.52 TO 12.5 MICRONS		

38. FIELD OF VIEW	39. GROUND SWATH
150.0 DEG	LIMB-TO-LIMB (4100 NM) FROM 750 NM ALT

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.4 DEG	4.1 NM FROM 750 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED CIRCULAR	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

RADIOMETERS MUST BE ABLE TO SCAN 150 DEG WITHOUT OBSTRUCTIONS

47. COMPONENTS

2 RADIOMETER-ELECTRONICS SYSTEMS, PROCESSOR, TAPE RECORDER

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
40 LB		14 WATTS			

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
			SENSITIVE	

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
2 COLD, 1 HOT EACH SCAN	DELAYED AND REALTIME	NIGHTTIME/DAYTIME

62. TELEMETRY REQUIREMENTS

BASEBAND BANDWIDTH IS 7.2 KHZ.

63. ADVANTAGES AND LIMITATIONS

HIGHER CALIBRATION ACCURACY IN VISIBLE THAN PRESENT CAMERAS, NOT SUBJECT TO SHADING. PROVIDES DAY AND NIGHT REALTIME IR DATA.

64. REFERENCES

1) DESIGN STUDY REPORT FOR THE IMPROVED TOS(ITOS)SYSTEM,V.1,2,3. RCA ASTRO-ELECTRONICS, CONTRACT NO. NAS5-9034, JUNE 7,68.***2) GOLDBERG,I.: METEOROLOGICAL IR INSTRUMENTS FOR SATELLITES, PRESENTED AT 13TH ANNUAL TECH. SYMP. OF SOCIETY OF PHOTO-OPTICAL INSTRUMENTATION ENGINEERS, AUG. 22, 1968.

65. HISTORICAL REMARKS

SCHEDULED FOR LAUNCH IN 1970

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
SOLAR-PROTON MONITOR	SPM	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
BOSTROM, C. O.	APPLIED PHYSICS LAB	301-776-7100
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
WILLIAMS, D.J.	GODDARD SPACE FLT CENTER	301-982-5808

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
	ESSA ES-86-67		11/66		INTEGRATION

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SIOMKAJLO, J.	ESSA/NESC		

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
APPLIED PHYSICS LAB	SILVER SPRING, MARYLAND		NA

26. INSTRUMENT TYPE	27. SECURITY
COUNTER, SOLID-STATE DETECTOR-ARRAY	UNC

28. APPLICATION	29. SPACECRAFT
PART-FLD	TIROS M

30. PURPOSE

PRIMARY-TO DETECT SOLAR PROTONS OVER AN EXTENDED PERIOD OF TIME IN THE VICINITY OF THE EARTH FOR: 1. EARLY WARNING OF THE OCCURRENCE OF SOLAR-PROTON EVENTS; 2. SYSTEMATIC MONITORING OF PROTON INTENSITIES AND SPECTRA; 3. RESEARCH IN SOLAR-TERRESTRIAL PHYSICS.

31. PRINCIPLES OF OPERATION

THE SPM CONSISTS OF 6 SOLID STATE DETECTORS. DETECTORS 1,2,3 & 6 ARE MOUNTED ON THE SPACECRAFT SO THAT THE AXES OF THE FOV ARE NEARLY PARALLEL TO THE EARTH'S MAGNETIC FIELD NEAR THE MAGNETIC POLES. DETECTORS 4 AND 5 ARE MOUNTED SUCH THAT THE AXES OF THEIR FOV ARE APPROXIMATELY PERPENDICULAR TO THE EARTH'S MAGNETIC FIELD EVERYWHERE. DETECTORS 1 AND 2 ARE SHIELDED BY HEMISPHERES, THE THICKNESS OF WHICH DETERMINES THE MINIMUM PROTON ENERGY REACHING THE DETECTOR. DETECTOR 1 IS SENSITIVE TO PROTONS ABOVE 60 MEV, AND DETECTOR 2 IS SENSITIVE TO PROTONS ABOVE 30 MEV. DETECTOR 3 IS SENSITIVE TO PROTONS ABOVE 10 MEV AND CONSISTS OF A LITHIUM-DRIFTED SOLID-STATE CUBE-SHAPED DETECTOR SURROUNDED BY AN ALUMINUM SHIELD. DETECTORS 1,2, AND 3 EACH HAVE A FOV OF 2 PI STERADIANS. DETECTORS 5 AND 6 EACH EMPLOY 2 DISK-SHAPED DETECTORS OF THE FULLY-DEPLETED, SURFACE-BARRIER TYPE, AND MEASURE PROTON ENERGIES BETWEEN 0.3 AND 10 MEV. EACH HAS A FOV OF 40 DEGREES. DETECTOR 4, WITH A FOV OF 15 DEGREES, COUNTS ELECTRONS ABOVE 50 KEV AND CONSISTS OF A 700 MICRON-THICK SURFACE-BARRIER DETECTOR. EACH DETECTOR HAS A PREAMPLIFIER-AMPLIFIER-DISCRIMINATOR UNIT ASSOCIATED WITH IT.

32. PHENOMENA OBSERVED

SOLAR PROTONS AND ALPHA-PARTICLES OVER THE POLAR CAPS

33. MEASUREMENT RANGE

SEE ITEM 31

34. PRECISION AND ACCURACY

SEE ITEM 31

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
NA	NA	

38. FIELD OF VIEW	39. GROUND SWATH
SEE ITEM 31	NA

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
NA	NA

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
NA		MED CIRCULAR	POLAR NA

46. SPECIAL REQUIREMENTS

DETECTORS SHOULD BE MAINTAINED BETWEEN -25 AND +25 DEGREES C.

47. COMPONENTS

DETECTORS, AMPLIFIERS, AND DISCRIMINATORS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
5 LB	0.1 CU FT	2 WATTS			

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
		SENSITIVE	SENSITIVE	

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
PRE-FLIGHT CALIBRATION	DELAYED AND REALTIME	CONTINUOUS

62. TELEMETRY REQUIREMENTS

DATA FRAME COMPRISES 20 NINE-BIT WORDS, FRAME TIME IS 12 SECS, WHICH CORRESPONDS TO 15 BITS/SEC. A DIGITAL ENCODER ASSIMILATES THE DATA FOR TRANSMISSION.

63. ADVANTAGES AND LIMITATIONS

WITH REAL TIME TELEMETRY EARLY WARNING OF INCREASE IN SOLAR PROTON INTENSITY COULD BE TRANSMITTED.

64. REFERENCES

1) BOSTROM, C.O. AND WILLIAMS, D.J.: PROPOSAL FOR SOLAR PROTON MONITOR FOR TIROS OPERATIONAL SAT. APPLIED PHYS LAB, AND GSFC. ***2) DESIGN STUDY REPORT FOR THE ITOS SYSTEM, VOL. 1,2. RCA ASTRO-ELECTRONICS, CONTRACT NO. NAS 5-9034, 1968.

65. HISTORICAL REMARKS

SCHEDULED FOR LAUNCH EARLY IN 1970.

66. DIAGRAMS

PART 2

APOLLO APPLICATIONS
(PROPOSALS ONLY)

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
DAY/NIGHT CAMERA SYSTEM	DNCS	S040
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
COONEY, T.B.	GODDARD SPACE FLT CENTER	301-982-2606
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
OSTROW, H.	GODDARD SPACE FLT CENTER	301-982-6563

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
NA	NA	NA	NA	INACT	FLT MODEL

18. MONITOR	19. AGENCY	20. PCM OFFICE	21. TELEPHONE
TERWILLIGER, R.G.	NASA HDQTRS	OSSA/SRB	202-962-0574

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
HAZELTINE CORP.	LITTLE NECK, NEW YORK	NA	21 MONTHS

26. INSTRUMENT TYPE	27. SECURITY
IMAGER, VISIBLE IMAGE-ORTHICON CAMERA	UNC

28. APPLICATION	29. SPACECRAFT
MET, ERSP	APOLLO APPLICATIONS

30. PURPOSE

PRIMARY-TO PROVIDE DATA TO DEMONSTRATE THE VALUE OF CLOUD COVER IMAGING IN BOTH THE DAY AND NIGHT PORTIONS OF THE EARTH. *** SECONDARY- TO DETERMINE THE EFFECT OF THE NIGHT GLOW BACKGROUND ON CLOUD COVER IMAGING UNDER CONDITIONS OF 'NO MOON'.

31. PRINCIRLES OF OPERATION

THIS IMAGE-ORTHICON TV CAMERA SYSTEM IS SIMILAR TO THE ONE ON ATS 4. HERE THERE IS NO STEERABLE MIRROR, AND THE LENS IS AN F/1.8, 9.5 MM FOCAL LENGTH TEGEA THAT GIVES A FOV OF 114.5 DEG. LIGHT FROM THE SCENE TO BE IMAGED PASSES THROUGH A BEAM SPLITTER AND 2 VARIABLE NEUTRAL DENSITY FILTERS. ONE BEAM IS FOCUSED ON A PHOTOMULTIPLIER TUBE, THE OTHER ON THE 0.84 X 0.84 INCH PHOTO-CATHODE OF THE IMAGE-ORTHICON TUBE. THE PHOTOMULTIPLIER OUTPUT CONTROLS THE POSITION OF THE FILTERS WHICH HAVE AN ATTENUATION RANGE OF 1,000,000. ELECTRONIC CONTROLS GIVE ANOTHER FACTOR OF 1,000 IN USEFUL RANGE. THREE PRACTICE FRAMES SET THE LIGHT LEVEL IN THE CAMERA AND GIVE A FINAL PICTURE WITH A BRIGHTNESS RANGE OF 10 LEVELS OF GRAY. EACH FRAME CONTAINS 840 LINES; 800 LINES OF SCENE, AND 40 LINES TO PROVIDE A GRAY SCALE CALIBRATION. FOUR SPECTRAL FILTERS MAY BE PLACED IN THE OPTICAL PATH UPON COMMAND. USABLE PICTURES SHOULD BE OBTAINED UNDER ANY ORBITAL LIGHTING CONDITIONS FROM NOON SUN TO STARLIGHT.

32. PHENOMENA OBSERVED

VISIBLE LIGHT REFLECTED FROM THE EARTH AND ITS CLOUD COVER

33. MEASUREMENT RANGE

FROM 0.0001 TO 10000 FT-LAMBERT

34. PRECISION AND ACCURACY

S/N OF 30 DB FOR MOONLIGHT; S/N OF 20 DB FOR STARLIGHT

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.3 TO 0.7 MICRON	NA	

38. FIELD OF VIEW	39. GROUND SWATH
96.0 BY 96.0 DEG	315 NM BY 315 NM FROM 140 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.2 DEG	0.5 NM FROM 140 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
10.0 DEG	0.2 DEG/SEC	LOW CIRCULAR	MEDIUM POSIGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

CAMERA, ELECTRONICS, TAPE RECORDER

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
55 LB	1.6 CU FT	23 WATTS	8 WATTS	57 WATTS	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
SEE ITEM 31	DELAYED AND REALTIME	CONTINUOUS

62. TELEMETRY REQUIREMENTS

REQUIRES 31 ANALOG AND DIGITAL CHANNELS PER WRITE CYCLE FOR HOUSEKEEPING DATA AND 2 CHANNELS FOR SCIENTIFIC DATA: 144-240KHZ FOR VIDEO DATA AND 50 KHZ FOR VIDEO DATA.

63. ADVANTAGES AND LIMITATIONS

64. REFERENCES

1) EXPERIMENT IMPLEMENTATION PLAN FOR MANNED SPACE FLIGHT EXPERIMENTS, FORM 1347, -DAY-NIGHT CAMERA SYSTEM (S039). OCTOBER 30, 1967.

65. HISTORICAL REMARKS

DUE TO DELAY IN AAP APPROVAL, INSTR DEVELOPMENT WAS NOT FUNDED.

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
DIELECTRIC-TAPE CAMERA	DTC	S040
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0003

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
BRODERICK, J.	GODDARD SPACE FLT CENTER	301-982-4108
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS	
NA	NA	NA	NA	INACT	PROTOTYPE	

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
TERWILLIGER, R.G.	NASA HDQTRS	OSSA/SRB	202-962-0574

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
RCA ASTRO-ELECTRONICS	PRINCETON, NEW JERSEY	NA	18 MONTHS

26. INSTRUMENT TYPE	27. SECURITY
IMAGER, VISIBLE SCANNING DIELECTRIC-TAPE CAMERA	UNC

28. APPLICATION	29. SPACECRAFT
MET, GEOL, AGRI, CART	APOLLO APPLICATIONS

30. PURPOSE

PRIMARY-TO DEMONSTRATE THE VALUE OF HIGH-RESOLUTION CLOUD-COVER TELEVISION FOR METEOROLOGY, GEOLOGY, AGRICULTURE, AND CARTOGRAPHY.***SECONDARY-TO GAIN EXPERIENCE WHICH WILL ASSESS THE USEFULNESS OF THE TAPE CAMERA AS A GENERAL PURPOSE HIGH-RESOLUTION EXPLORATORY DEVICE FOR FUTURE LUNAR OR PLANETARY MISSIONS.

31. PRINCIPLES OF OPERATION

IN THIS INSTRUMENT A SCANNING MIRROR AND A NARROW ANGLE LENS FOCUS A SCENE IMAGE THROUGH A NARROW SLIT ONTO A DIELECTRIC TAPE. THE SLIT IS ORIENTED WITH ITS LONG AXIS ACROSS THE WIDTH OF THE TAPE. LIGHT REACHES THE TAPE ONLY THROUGH THIS SLIT SO THAT AN IMAGE IS STORED AS THE TAPE MOVES UNDER THE SLIT IN SYNCHRONISM WITH THE SCANNING MIRROR. THE MIRROR SCANS THE EARTH NORMAL TO THE GROUND TRACK, AND A FRAME CONSISTS OF ONE SUCH SCAN. THIS COVERS AN ANGULAR AREA OF 8 DEG BY 50 DEG. UP TO 270 FRAMES PER ORBIT MAY BE STORED ON THE 100 FT OF TAPE IN THE CAMERA. THIS TAPE IS A CRONAR-BASE MATERIAL COATED WITH A THIN INSULATING LAYER AND A PHOTOCONDUCTING LAYER. WHEN A SPOT OF LIGHT STRIKES THE PHOTOCONDUCTOR, CHARGES IN THE INSULATOR AT THIS SPOT LEAK OFF. AN IMAGE THEN IS STORED AS VARIATIONS IN CHARGE ON THE INSULATOR. THE IMAGE STORAGE TIME IS LONG COMPARED TO AN ORBIT PERIOD. THE TAPE IS READ ON COMMAND BY AN ELECTRON BEAM WHICH IS MODULATED BY THE STORED CHARGE ON THE TAPE. A FLOOD GUN IS USED TO ERASE OLD INFORMATION SO THAT THE TAPE MAY BE USED AGAIN AND AGAIN. THE TAPE IS CAPABLE OF STORING IMAGES WITH 17 LINE-PAIRS PER MILLIMETER RESOLUTION.

32. PHENOMENA OBSERVED

SOLAR RADIATION REFLECTED FROM THE EARTH AND CLOUDS

33. MEASUREMENT RANGE

32:1 CONTRAST CAPABILITY REPRODUCED OVER 10 GRAY SCALE STEPS

34. PRECISION AND ACCURACY

SIGNAL TO NOISE RATIO IS 38 DB

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.35 TO 0.7 MICRON	NA	

38. FIELD OF VIEW	39. GROUND SWATH
8.0 BY 50.0 DEG	20 NM BY 130 NM FROM 140 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.02 DEG	300 FT FROM 140 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION	
10.0 DEG	0.15 DEG/SEC	LOW CIRCULAR	MEDIUM	POSIGRADE

46. SPECIAL REQUIREMENTS

THE DAY-NIGHT CAMERA SYSTEM (S039) IS USED FOR COMPARISON

47. COMPONENTS

CAMERA ASSEMBLY, ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
83 LB	2.0 CU FT	27 WATT	6 WATT	55 WATTS	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
NONE		NONE	SENSITIVE	

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
	DELAYED TELEMETRY	CONTINUOUS

62. TELEMETRY REQUIREMENTS

35 ANALOG CHANNELS FOR TELEMETRY ONCE PER WRITE CYCLE AND ONE VIDEO CHANNEL (680 KC) FOR SCIENTIFIC DATA FOR 6 MINUTES DURING EACH READOUT CYCLE.

63. ADVANTAGES AND LIMITATIONS

HIGH RADIATION RESISTANCE OF THE DIELECTRIC TAPE.

64. REFERENCES

1) NASA EXPERIMENTATION PLAN FOR MANNED SPACE FLIGHT EXPERIMENTS-DIELECTRIC TAPE CAMERA (S040). OCT 30, 1967.***2) APPLICATIONS A AND B PHASE B INTEGRATION STUDY DOCUMENT. NASA/MSC, APRIL 1967. ***3) DIELECTRIC TAPE CAMERA. RCA ASTRO-ELECTRONICS DIV.

65. HISTORICAL REMARKS

DUE TO DELAY IN AAP APPROVAL, INSTR DEVELOPMENT WAS NOT FUNDED

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
DUAL-CHANNEL SCANNING IMAGER	DCSI	S102
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0003

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
HOLTER, M.R.	UNIVERSITY OF MICHIGAN	313-483-0500
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
NA	NA	NA	NA		INACCT PROPOSAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
TERHILLIGER, R.G.	NASA HDQTRS	OSSA/SRB	202-962-0574

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
NA	NA	NA	18 MONTHS

26. INSTRUMENT TYPE	27. MEASUREMENTS
IMAGER, DUAL-CHANNEL IR/VISIBLE SCANNING	PRO

28. APPLICATION	29. SPACECRAFT
ERSP, MET	APOLLO APPLICATIONS

30. PURPOSE

PRIMARY-TO RECORD IN GRAPHIC FORM THE TERRAIN RADIANCE AS OBSERVED SIMULTANEOUSLY IN TWO SPECTRAL BANDS (EMISSION AND REFLECTION). ***SECONDARY-TO DETERMINE THE ROLE AND VALUE OF THE MULTIBAND SCANNER IN ORBITAL EARTH RESOURCES SURVEY OPERATIONS AND TO GENERATE THE INFORMATION NEEDED FOR AN OPERATIONAL SYSTEM.

31. PRINCIPLES OF OPERATION

THE PROPOSED INSTRUMENT WILL RECORD IN GRAPHIC FORM THE TERRAIN RADIANCE AS OBSERVED SIMULTANEOUSLY IN 2 SPECTRAL BANDS: A REFLECTIVE CHANNEL, 0.6-0.7 MICRONS; AND AN IR CHANNEL, 10.0-12.5 MICRONS. THE SCANNER WILL HAVE AN INSTANTANEOUS FIELD OF VIEW OF ONE MILLIRADIAN AND A TOTAL SCAN ANGLE OF 80 DEG WHICH WILL GIVE A GROUND RESOLUTION OF APPROX 840 FT FROM A 140 NM ALTITUDE. A SCAN RATE OF 30 LINES PER SECOND WILL PROVIDE CONTIGUOUS SCAN LINES IN THE STRIP MAP. THE SCANNER CONSISTS OF A FLAT, SCANNING 45 DEG MIRROR AND REFLECTIVE IMAGING OPTICS. THE MIRROR SCANS THE TERRAIN BENEATH THE VEHICLE AND ACROSS THE GROUND TRACK. THE RADIATION IS REFLECTED THROUGH THE TELESCOPE AND ONTO A BEAM SPLITTER. ENERGY IN THE 10-12.5 MICRON BAND PASSES THROUGH THE SPLITTER AND IS FOCUSED ONTO A CRYOGENICALLY COOLED THERMAL DETECTOR. WAVELENGTHS LESS THAN 1 MICRON ARE REFLECTED AND PASS THROUGH A FILTER ONTO A PHOTOMULTIPLIER. THE TWO SIGNALS PROCEED TO THE PHOTORECORDER UNIT WHERE THE SIGNALS MODULATE A CRT OR GLOW-TUBE PRINTER FOR DIRECT FILM RECORDING. THE SCANNER ASSEMBLY INCLUDES REFERENCE DEVICES AND OPTICS TO PROVIDE CALIBRATION PULSES DURING THE INACTIVE PORTION OF EACH SCAN.

32. PHENOMENA OBSERVED

TERRAIN RADIANCE IN TWO SPECTRAL BANDS, VISIBLE AND IR.

33. MEASUREMENT RANGE

16 LEVELS OF GRAY PROVIDE A RANGE OF +-8 KELVIN DEG AT 320 DEG K

34. PRECISION AND ACCURACY

VIS: ACCURACY =0.67 PERCENT; IR:VARIABLE, +-1 K DEG AT 320 DEG K

35. SPECTRAL RANGE | 36. SPECTRAL RESOLUTION | 37. TIME CONSTANT

0.6 TO 12.5 MICRONS NA

38. FIELD OF VIEW | 39. GROUND SWATH

80.0 BY 0.06 DEG 235 NM BY 840 FEET FROM 140 NM ALTITUDE

40. ANGULAR RESOLUTION | SPATIAL RESOLUTION

0.06 DEG 840 FEET FROM 140 NM ALTITUDE

42. POINTING ACCURACY | 43. POINTING RATE | 44. ALTITUDE | 45. INCLINATION

2.0 DEG 0.4 DEG/SEC LOW CIRCULAR MEDIUM POSIGRADE

46. SPECIAL REQUIREMENTS

CRYOGENIC COOLING TO APPROX 28 DEG K REQUIRED FOR IR CHANNEL

47. COMPONENTS

SCANNER, COOLANT, RECORDER

48. WEIGHT | 49. VOLUME | 50. AVERAGE POWER | 51. STANDBY POWER | 52. PEAK POWER | 53. MTBF

100 LB 3.0 CU FT 60 WATTS 25 WATTS 75 WATTS

54. INTERSERVICE | 55. INTERFERENCE | 56. MAGNETIC | NUCLEAR | THERMAL | 57. INTERREACTION | 58. SHIELDING

SENSITIVE

61. CALIBRATION | 62. DATA RECOVERY | 63. FREQUENCY OF OBSERVATION

SEE ITEM 31 MANNED RETURN AS PROGRAMMED

64. TELEMETRY REQUIREMENTS

NOT NEEDED, VOICE COMMUNICATION DESIRABLE

65. ADVANTAGES AND LIMITATIONS

66. REFERENCES

1) EXPERIMENT IMPLEMENTATION PLAN FOR MANNED SPACE FLIGHT EXPERIMENTS;DUAL-CHANNEL SCANNER-IMAGER (S102). NASA, OCT 30,67.

67. HISTORICAL REMARKS

DUE TO DELAY IN AAP APPROVAL, INSTR DEVELOPMENT WAS NOT FUNDED.

68. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
ELECTRICALLY-SCANNING MICROWAVE RADIOMETER	ESMR	S075
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
THADDEUS, DR. P.	GODDARD INST SPACE STUDY	212-866-3600-X210
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
NA	NA	NA	NA	INACT	PROPOSAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
TERWILLIGER, R.G.	NASA HDQTRS	OSSA/SRB	202-962-0574

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
SPACE GENERAL CORP.	EL MONTE, CALIFORNIA	NA	18 MONTHS

26. INSTRUMENT TYPE	27. ACQUISITION
RADIOMETER, ELECTRICALLY-SCANNING MICROWAVE	UNC

28. APPLICATION	29. SPACECRAFT
MET, ATM-PHYS	APOLLO APPLICATIONS

30. PURPOSE

PRIMARY-TO MAP THE BRIGHTNESS TEMPERATURE OF THE EARTH AT THE CHOSEN WAVELENGTH ON A GLOBAL SCALE, IN ORDER THAT CORRELATIONS CAN BE MADE BETWEEN THESE MICROWAVE TEMPERATURES AND METEOROLOGICAL OR GEOPHYSICAL PHENOMENA.

31. PRINCIPLES OF OPERATION

THE MICROWAVE RADIOMETER IS A SMALL RADIO TELESCOPE DESIGNED TO MAKE MEASUREMENTS (ABSOLUTE ACCURACY TO 1.12 DEG K WITH A STANDARD DEVIATION OF 0.7 DEG K) OF THE INTENSITY OF THERMAL RADIATION AT A WAVELENGTH OF 1.55 CM (A FREQUENCY OF 19.35 GHZ). WITH A 200 MHZ BANDWIDTH, THE RADIOMETER CONSISTS OF A MICROWAVE RECEIVER AND A 2 DIMENSIONAL PHASED ARRAY ANTENNA CONTAINING 49 LINEAR ARRAYS. THE ANTENNA IS DESIGNED TO SCAN ELECTRONICALLY OVER 39 DISCRETE POSITIONS OUT TO 50 DEG ON EACH SIDE OF THE NADIR, IN A LINE PERPENDICULAR TO THE GROUND TRACK OF THE S/C. THE ANGULAR RESOLUTION OF THE ANTENNA IS 2.7 DEG (3 DB POINTS) AT NADIR AND 3 DEG AT THE MAXIMUM SCAN POSITION. THE NOISE TEMPERATURE OF THE ANTENNA IS 1040 DEG K, AND THE SIDE LOBES CONTRIBUTE A MAXIMUM OF 6 PERCENT TO THE SIGNAL. THE INTEGRATION TIME FOR EACH SCAN STEP IS 40 MSEC, AND THE RESULTING SIGNAL IS READ AS A 10 BIT WORD. THE RADIOMETER IS CALIBRATED USING A SKY HORN FOR THE COLD REFERENCE AND AN INTERNAL SOURCE FOR A HOT REFERENCE TEMPERATURE.

32. PHENOMENA OBSERVED

INTENSITY AT 1.55 CM (MICROWAVE) OF THERMAL RADIATION FROM EARTH

33. MEASUREMENT RANGE

DYNAMIC RANGE = 50 TO 330 DEG K

34. PRECISION AND ACCURACY

ABSOLUTE ACCURACY = 1.12 K DEG

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
19.35 GHZ	200. MHZ	

38. FIELD OF VIEW	39. GROUND SWATH
100. DEG	330 NM DIAM CIRCLE FROM 125 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
2.7 DEG	7 NM FROM 140 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
2.0 DEG	NA	LOW CIRCULAR	MEDIUM POSIGRADE

46. SPECIAL REQUIREMENTS

ANTENNA MUST HAVE UNOBSTRUCTED VIEW OF THE EARTH

47. COMPONENTS

ANTENNA, ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
30 LB	1.5 CU FT	20 WATTS	18 WATTS	28 WATTS	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
SENSITIVE				

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
SEE ITEM 31	DELAYED TELEMETRY	AS PROGRAMMED

62. TELEMETRY REQUIREMENTS

10 BIT WORD READ EACH 40 MILLSEC, SERIAL READOUT FOR SIGNAL, AND THREE HOUSEKEEPING SIGNALS

63. ADVAN. AGES AND LIMITATIONS

FREQUENCY AVOIDS MAN-MADE NON-THERMAL INTERFERENCE ORIGINATING EITHER ON THE GROUND OR ON THE S/C.

64. REFERENCES

1) NASA EXPERIMENT IMPLEMENTATION PLAN FOR MANNED SPACE FLIGHT EXPERIMENTS-ELEC-SCAN MICROWAVE RADIOMETER (S075), OCT 30,1967.

65. HISTORICAL REMARKS

DUE TO DELAY IN APP APPROVAL, INSTR DEVELOPMENT WAS NOT FUNDED

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
FILTER-WEDGE SPECTROMETER	FWS	S045
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
HOVIS, W.A.	GODDARD SPACE FLT CENTER	301-982-6465
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
NA	NA	NA	NA	INACT	PROPOSAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
TERWILLIGER, R.G.	NASA HDQTRS	OSSA/SRB	202-962-0574

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
		NA	18 MONTHS

26. INSTRUMENT TYPE	27. SECURITY
SPECTROMETER, CIRCULAR-WEDGE-INTERFERENCE-FILTER INFRARED	UNC

28. APPLICATION	29. SPACECRAFT
MET, ERSP	APOLLO APPLICATIONS

30. PURPOSE

PRIMARY - TO INVESTIGATF WITH HIGH RESOLUTION THE IR SPECTRA RECEIVED BY AN INSTRUMENT ABOVE THE ATMOSPHERE AND TO STUDY THE EFFECTS OF ABSORPTION IN THE ATMOSPHERE AND SCATTERING BY DUST PARTICLES.***SECONDARY - TO EVALUATE THE ABILITY OF THE SPECTROMETER TO DETERMINE GROUND CONDITIONS.

31. PRINCIPLES OF OPERATION

THIS IR SPECTROMETER CONSISTS OF A TELESCOPE WITH AN F/2 120-MM FOCAL-LENGTH CALCIUM-FLUORIDE LENS, A ROTATING CHOPPER, SYNCHRONOUS MOTORS FOR THE CHOPPER AND FILTER WEDGE, A LEAD SELENIDE DETECTOR WITH A LIQUID-NITROGEN COOLING SYSTEM, AND THE FILTER-WEDGE ITSELF. THIS IS A 10-CM (4 INCH) DIAMETER ROTATING INTERFERENCE FILTER THAT, WITH A BLOCKING FILTER, TRANSMITS ONLY A NARROW WAVELENGTH BAND WHOSE CENTER WAVELENGTH VARIES WITH ROTATION ANGLE. HALF THE WEDGE COVERS A SPECTRAL RANGE OF 1.5 TO 6 MICRONS, AND THE OTHER HALF COVERS 8 TO 16 MICRONS. THE RATIO OF PASSBAND TO CENTRAL WAVELENGTH IS EQUAL TO 0.01. A SPECTRAL SCAN (ONE REVOLUTION OF THE WEDGE) TAKES 15 SEC. THE ANGULAR POSITION OF THE WEDGE IS MONITORED AT 2 POINTS DURING EACH ROTATION; THIS DETERMINES WAVELENGTH AS A FUNCTION OF TIME. THE CHOPPER ALTERNATELY EXPOSES THE DETECTOR TO INCOMING RADIATION AND THAT FROM A KNOWN BLACKBODY. AT 4 MICRONS THE SIGNAL TO NOISE RATIO JUST FROM REFLECTED SOLAR ENERGY IS ESTIMATED TO BE 260. THIS RISES SHARPLY AT SHORTER WAVELENGTHS. THE S/N FOR LONGER WAVELENGTHS VARIES WITH THE STATE OF THE ATMOSPHERE AND THE SURFACE IN THE FOV. VERTICAL TEMPERATURE PROFILES AND WATER VAPOR CONTENT CAN BE INFERRED USING INVERSION TECHNIQUES.

32. PHENOMENA OBSERVED

IR RADIATION REFLECTED AND EMITTED FROM THE EARTH'S ATMOSPHERE

33. MEASUREMENT RANGE

34. PRECISION AND ACCURACY

SIGNAL MEASURED TO ONE PART IN 500

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
1.5 TO 16.0 MICRONS		50. MICRSEC

38. FIELD OF VIEW	39. GROUND SWATH
1.0 BY 3.0 DEG	3.5 NM BY 10.5 NM FROM 200 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
NA	NA

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
2.0 DEG	0.5 DEG/SEC	LOW CIRCULAR	MEDIUM POSIGRADE

46. SPECIAL REQUIREMENTS

REQUIRED SUPPORT EXPTS ARE: IRIS, ITPR, AND IR COLOR PHOTOGRAPHY

47. COMPONENTS

OPTICAL SYSTEM, COOLING SYSTEM

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
30 LB	1.3 CU FT	7 WATTS		5 WATTS	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
			SENSITIVE	

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
MEASUREMENT OF BLACK BDY	DELAYED TELEMETRY	AS PROGRAMMED

62. TELEMETRY REQUIREMENTS

CHANNEL 1 CONTAINS 130 SPECTRAL ELEMENTS, AND CHANNEL 2 CONTAINS 54. EACH ELEMENT CONTAINS 10 BITS. 15 SEC ARE REQUIRED TO SCAN EACH WHEEL. TOTAL DATA RATE IS 125 BPS. A DATA RUN LASTS 30 MIN.

63. ADVANTAGES AND LIMITATIONS

64. REFERENCES

1) APPLICATIONS A AND B PHASE B INTEGRATION STUDY DOCUMENT. NASA/MSC, APRIL 1967.

65. HISTORICAL REMARKS

SIMILAR INSTRUMENT SCHEDULED TO FLY ON NIMBUS D.

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
INFRARED INTERFEROMETER/SPECTROMETER	IRIS	S049
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0003

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
HANEL, DR. R.A.	GODDARD SPACE FLT CENTER	301-982-4528
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
NA	NA	NA	NA	INACT	FLT MODEL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
TERWILLIGER, R.G.	NASA HDQTRS	OSSA/SRB	202-962-0574

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
TEXAS INSTRUMENTS	DALLAS, TEXAS	NA	21 MONTHS

26. INSTRUMENT TYPE	27. SPECIFIC
SPECTROMETER, MICHELSON INTERFEROMETER	UNC

28. APPLICATION	29. SPACECRAFT
MET, AGRI, GEOL, PLAN-ATM	APOLLO APPLICATIONS

30. PURPOSE

PRIMARY-TO MEASURE TEMP PROFILES, WATER VAPOR DISTRIBUTION, AND OZONE CONCENTRATION: TO DETECT AND MEASURE CH4, N20, AND OTHER MINOR ATMOSPHERIC CONSTITUENTS; AND TO ANALYZE THE EFFECTS OF CLOUDS AND HAZE ON THE METHODS OF DETERMINATION OF THE ABOVE.*** SECONDARY - TO STUDY THE IR CHARACTERISTICS OF GEOLOGICAL AND AGRICULTURAL SURFACES IN THE 8-12 MICRON WINDOW.

31. PRINCIPLES OF OPERATION

THE PROPOSED INSTRUMENT FOR THIS EXPERIMENT IS A TWYMAN-GREEN MODIFICATION OF A MICHELSON INTERFEROMETER/SPECTROMETER. IT IS ESSENTIALLY IDENTICAL TO THE NIMBUS 3 AND D INSTRUMENT EXCEPT FOR A SOLID-NEON COOLED COPPER-DOPED GERMANIUM DETECTOR, SIZED AND POSITIONED TO PROVIDE A 2 DEGREE FIELD OF VIEW. THE INSTRUMENT WILL BE CAPABLE OF 0.07-MICRON RESOLUTION AT THE MEDIAN OF THE SPECTRAL RANGE OF 5.0 TO 22.0 MICRONS. RECEIVED RADIATION IS DIVIDED BY THE BEAMSPLITTER INTO 2 COMPONENTS WHICH RECOMBINE AND INTERFERE AFTER REFLECTIONS ON THE FIXED AND MOVING MIRRORS RESPECTIVELY. THE RECOMBINED BEAM, FOCUSED ON THE DETECTOR, IS MODULATED BY THE MOTION OF THE SCAN MIRROR. THE MODULATION IS PROPORTIONAL TO THE SPEED OF THE MIRROR AND THE WAVE NUMBER OF THE INCIDENT RADIATION. THE OUTPUT SIGNAL FROM THE DETECTOR, CALLED THE INTERFEROGRAM, IS THE FOURIER TRANSFORM OF THE SPECTRUM OF THE INCIDENT RADIATION. AFTER A PREDETERMINED NUMBER OF INTERFEROGRAMS HAVE BEEN RECORDED, TWO CALIBRATION INTERFEROGRAMS ARE OBTAINED, ONE FOR A BLACK BODY AT 300 DEG K AND ONE FOR OUTER SPACE AT NEAR 0 DEG K.

32. PHENOMENA OBSERVED

THERMAL EMISSION OF THE EARTH'S SURFACE AND ATMOSPHERE

33. MEASUREMENT RANGE

NEAR 0 TO 300 DEG K

34. PRECISION AND ACCURACY

ABSOLUTE ACCURACIES OF INTENSITY BETTER THAN 1 PERCENT.

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
5.0 TO 22.0 MICRONS	0.85 PERCENT	

38. FIELD OF VIEW	39. GROUND SWATH
2.0 DEG	5 NM DIAM CIRCLE FROM 140 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
2.0 DEG	5 NM FROM 140 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
.5 DEG	0.05 DEG/SEC	LOW CIRCULAR	MEDIUM POSIGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

SPECTROMETER, ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
58 LB	1.82 CU FT	14 WATTS	5 WATTS	25 WATTS	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
			SENSITIVE	THERMAL SHIELD PROVIDED

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
SEE ITEM 31	DELAYED TELEMETRY	AS PROGRAMMED

62. TELEMETRY REQUIREMENTS

3.75 KBS IN 10-BIT WORDS, 1 CHANNEL

63. ADVANTAGES AND LIMITATIONS

64. REFERENCES

1) NASA EXPERIMENT IMPLEMENTATION PLAN FOR MANNED SPACE FLIGHT EXPERIMENTS FOR IR INTERFEROMETER SPECTROMETER (S049),OCT 67.***
2) MINZNER, R.A. ED.: INTERIM REPORT ON SATELLITE METEOROLOGICAL INSTRUMENTS, NASA/ERC PM-6713, JUNE 1967.

65. HISTORICAL REMARKS

DUE TO DELAY IN AAP APPROVAL, INSTR DEVELOPMENT WAS NOT FUNDED.

66. DIAG [illegible]

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE				2. ACRONYM	3. EXP NO
INFRARED TEMPERATURE-PROFILE RADIOMETER				ITPR	S050
(TITLE CONT.)				4. RESUMP DATE	15.
				11/10/69	0003
6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION		8. TELEPHONE		
SMITH, DR. W.L.	NAT ENVIRON SAT CTR, ESSA		301-440-7221		
9. CO-INVESTIGATOR	10. ORGANIZATION		11. TELEPHONE		
WARK, D.Q.	NAT ENVIRON SAT CTR, ESSA		301-440-7114		
12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
NA	NA	NA	NA	INACT	PROTOTYPE
18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE		
TERWILLIGER, R.G.	NASA HDQTRS	OSSA/SRB	202-962-0574		
22. VENDOR	23. LOCATION		24. FLIGHT DATE	25. LEAD TIME	
NA	NA		NA	21 MONTHS	
26. INSTRUMENT TYPE				27. RESUMPTION	
RADIOMETER, MULTI-CHANNEL SCANNING FILTER IR				UNC	
28. APPLICATION	29. SPACECRAFT				
MET	APOLLO APPLICATIONS				

30. PURPOSE

PRIMARY-TO DETERMINE A SIMPLIFIED THREE-DIMENSIONAL TEMPERATURE FIELD OF THE EARTH'S ATMOSPHERE FOR METEOROLOGICAL PURPOSES.*** SECONDARY - TO PROVIDE CONTROLLED TESTING OF THE PERFORMANCE OF THE INSTRUMENT.

31. PRINCIPLES OF OPERATION

THIS INSTRUMENT IS A MODIFIED VERSION OF THE MEDIUM RESOLUTION SCANNING IR FILTER RADIOMETER FLOWN SUCCESSFULLY ON NIMBUS. THE INSTRUMENT IS DESIGNED TO MEASURE THE IR ENERGY FROM THE EARTH-ATMOSPHERE SYSTEM IN 7 SPECTRAL INTERVALS CENTERED AT 18.6, 14.4, 14.1, 13.8, 13.3, 11.1, AND 3.8 MICRON WITH SPECTRAL BANDPASSES VARYING FROM 0.4 TO 1.0 MICRON. THE INSTRUMENT HAS A TIME CONSTANT OF A FEW MILLISECONDS. A CONSTANT ORIENTATION OF THE INSTRUMENT IS REQUIRED, WITH THE SWATH PASSING SYMMETRICALLY THROUGH OR NEAR THE SUB-SATELLITE POINT. A VIEW OF SPACE IS REQUIRED PERIODICALLY FOR A ZERO REFERENCE. THE RADIOMETER ASSEMBLY CONSISTS OF THE SCANNING MIRROR, PRIMARY OPTICAL ELEMENTS, FILTERS, DETECTORS AND PREAMPLIFIERS. AN ELECTRONICS ASSEMBLY CONTAINS THE INPUT AND MIXER CIRCUITS, SIGNAL DRIVER AMPLIFIERS, SYNCHRONOUS DETECTORS AND OUTPUT FILTERS, ELECTRONICS MODULE POWER SUPPLY, PREAMPLIFIER BIAS SUPPLY, BOLOMETER POWER SUPPLY, AND REFERENCE SIGNAL AND OFF-SET VOLTAGE GENERATOR. RADIOSONDE DATA CONCURRENT WITH SPACECRAFT ACQUIRED DATA ARE NEEDED TO COMPARE ACTUAL TEMPERATURE PROFILES WITH THOSE DETERMINED FROM THE ITPR DATA USING MATHEMATICAL INVERSION TECHNIQUES.

32. PHENOMENA OBSERVED

INFRARED RADIATION EMITTED BY THE EARTH AND ATMOSPHERE

33. MEASUREMENT RANGE

34. PRECISION AND ACCURACY

S/N WILL BE 100 TO 1 OR BETTER FOR ALL CHANNELS

11.1 TO 18.6 MICRONS 1.0 MICRON

6.0 BY 6.0 DEG 12 NM BY 12 NM FROM 120 NM ALTITUDE

6.0 DEG 12 NM FROM 120 NM ALTITUDE

1.0 DEG 1.0 DEG/SEC LOW CIRCULAR MEDIUM POSIGRADE

TEMPERATURE RANGE -15 TO 50 DEG C; NO DIRECT SUNLIGHT IN FOV

RADIOMETER, ELECTRONICS

WT (LB)	VOL (CU FT)	AVERAGE POWER	PEAK POWER	ANTGR
24 LB	0.6 CU FT	15 WATTS	NONE	24 WATTS

SENSITIVE

CALIBRATION: PERIODIC VIEW OF SPACE

DATA RECOVERY: DELAYED TELEMETRY

PERIOD/UNIT OF OBSERVATION: AS PROGRAMMED

TELEMETRY REQUIREMENTS

DATA RATE IS 10 WORDS PER SECOND; A TOTAL OF 25 CHANNELS IS REQUIRED FOR IR DATA, INTERNAL REFERENCE AND HOUSEKEEPING. THE IR DATA IS SENT IN ANALOG FORM.

ADVANTAGES AND LIMITATIONS

REFERENCES

1) NASA EXPERIMENT IMPLEMENTATION PLAN FOR MANNED FLIGHT EXPTS - IR TEMPERATURE PROFILE RADIOMETER (S050). OCTOBER 30, 1967.

HISTORICAL REMARKS

DUE TO DELAY IN AAP APPROVAL, INSTR DEVELOPMENT WAS NOT FUNDED

DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
INFRARED TEMPERATURE-SOUNDING EXPERIMENT	IRT	S043
-(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
SHAW, DR. J.H.	OHIO STATE UNIVERSITY	614-293-7968
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
NA	NA	NA	NA	INACT	PROPOSAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
TEBWILLIGER, R.G.	NASA HDQTRS	OSSA/SRB	202-962-0574

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
NA	NA	NA	21 MONTHS

26. INSTRUMENT TYPE

SPECTROMETER, IR FIXED-GRATING MULTIDETECTOR RADIOMETER PRO

28. APPLICATION	29. SPACECRAFT
MET	APOLLO APPLICATIONS

30. PURPOSE

PRIMARY-TO DETERMINE THE ATMOSPHERIC TEMPERATURE AND WATER VAPOR VERTICAL PROFILES WITH EMPHASIS ON HIGH VERTICAL RESOLUTION. *** SECONDARY-TO DETERMINE THE SURFACE OR CLOUD TOP TEMPERATURES AND PERCENT CLOUD COVER.

31. PRINCIPLES OF OPERATION

THE SYSTEM CONSISTS OF A MODIFIED EBERT FIXED GRATING SPECTROMETER PLUS A FILTER RADIOMETER. RADIATION FROM A 12 BY 12 DEGREE FOV ENTERS THE F/3 SYSTEM OF THE SPECTROMETER. A 250-LINE-PER-MM GRATING THAT IS THE LIMITING APERTURE OF THE SYSTEM DISPERSES THE LIGHT TO 15 SEPARATE, LEAD-SELENIDE (PBSE) DETECTORS COOLED TO 193 DEG K. THEY COVER SPECTRAL INTERVALS IN THE REGION 3.5 TO 6.0 MICRONS AND ARE DESIGNED TO GIVE A RESOLUTION OF 1 PERCENT. THE OUTPUT IS USED IN A MATHEMATICAL INVERSION OF THE RADIATIVE TRANSFER EQUATION FOR A VERTICAL TEMPERATURE PROFILE UP TO THE 1 MB LEVEL. A TUNING FORK CHOPPER OPERATING AT ABOUT 300 HZ AT THE ENTRANCE SLIT PROVIDES A TEMPERATURE REFERENCE BY MAINTAINING AND MEASURING THE TEMPERATURE OF THE CHOPPER'S INNER SURFACE TO 0.1 DEG K. THE FILTER RADIOMETER CONTAINS 5 CHANNELS EACH RESPONDING TO 4.6 TO 6.0 MICRON RADIATION TO GIVE CLOUD COVER DATA. HOWEVER, EACH CHANNEL COVERS A DIFFERENT 2.4 BY 2.4 DEGREE POETION OF THE SPECTROMETER'S 2.4 BY 12 DEG FOV. BY SAMPLING THE RADIOMETER 5 TIMES DURING THE 21.2 SEC INTEGRATION PERIOD OF THE SPECTROMETER AND ALLOWING FOR S/C MOTION, A 25 ELEMENT RADIANCE MAP OF THE SPECTROMETER VIEW IS OBTAINED. AN INTERNAL BLACKBODY PROVIDES PERIODIC CALIBRATION.

32. PHENOMENA OBSERVED

REFLECTED AND EMITTED RADIATION FROM THE EARTH AND ATMOSPHERE

33. MEASUREMENT RANGE

DYNAMIC RANGE: 10,000; RADIANCE VALUES 200 TO 300 K.

34. PRECISION AND ACCURACY

1 PERCENT OF MEASURED RADIANCE VALUE

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
3.46 TO 6.05 MICRONS	1.0 PERCENT	50. MICRSEC

38. FIELD OF VIEW	39. GROUND SWATH
12.0 BY 12.0 DEG	30 NM BY 30 NM FROM 140 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
2.4 DEG	6 NM FROM 140 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	ORBIT DURATION
1.0 DEG	0.2 DEG/SEC	LOW CIRCULAR MEDIUM	POSIGRADE

46. SPECIAL REQUIREMENTS

CLEAR FOV OF 12 BY 12 DEGREES; NO WINDOW MATERIAL IS PERMISSIBLE

47. COMPONENTS

RADIOMETER HEAD, ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	PEAK POWER
25 LB	1.2 CU FT	50 WATTS 40 WATTS	60 WATTS

52. ENVIRONMENTAL	53. NUCLEAR	54. THERMAL	55. ELECTRICAL
		SENSITIVE	

56. CALIBRATION	57. DATA RECORDING	58. DATA TRANSMISSION
INTERNAL BLACKBODY	DELAYED TELEMETRY	AS PROGRAMMED

59. SPECIAL REQUIREMENTS

1 DIGITAL CHANNEL, 1000 BPS, 10 BIT WORDS

62. ACKNOWLEDGEMENTS

63. REFERENCES

1) NASA EXPERIMENT IMPLEMENTATION PLAN FOR MANNED SPACE FLIGHT EXPERIMENTS FOR IR TEMPERATURE SOUNDING (S043). OCTOBER 30, 1967

64. REMARKS

ENGINEERING MODEL BUILT AND SUCCESSFUL BALLOON FLIGHT JULY 1968.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE		2. ACRONYM / TASK NO.	
METRIC CAMERA		MCS	S100
(TITLE CONT.)		4. RESUME DATE	5. [illegible]
SPECIAL		11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
SCHMID, DR. H.H.	ESSA-INST FOR EARTH SCI	301-496-8531
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. PUBLISHER NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
NA	NA	NA	NA	INACT	PROPOSAL

18. MONITOR	19. AGENCY	20. PLN OFFICE	21. TELEPHONE
TERWILLIGER, R.G.	NASA HDQTRS	OSSA/SAB	202-962-0574

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME	26. QUANTITY
CARL ZEISS, INC.	444 5TH AVE.N.Y., N.Y.	NA	18 MONTHS	1

27. INSTRUMENT TYPE		28. STATUS
IMAGER, 6-INCH VISIBLE-SPECTRUM METRIC CAMERA, STEREO		UNC
29. APPLICATION	30. SPACECRAFT	
ERSP, GEOD	APOLLO APPLICATIONS	

30. PURPOSE

PRIMARY-TO OBTAIN HIGH PRECISION METRIC PHOTOGRAPHY FROM EARTH ORBITING SATELLITES TO DETERMINE THE CAMERA'S POTENTIAL FOR GEODESY AND CARTOGRAPHY.***SECONDARY-TO PROVIDE SAMPLE PHOTOGRAPHY FOR PHOTO-INTERPRETATION IN GEOGRAPHY, GEOLOGY, FORESTRY, AND OTHER EARTH RESOURCES DISCIPLINES.

31. PRINCIPLES OF OPERATION

THE PHOTOGRAMMETRIC CAMERA WILL BE USED TO OBTAIN STEREO COVERAGE OVER SELECTED SITES. UNIVERSAL-TIME-CORRELATED STAR PHOTOGRAPHY, TAKEN SIMULTANEOUSLY WITH THE GROUND PHOTOGRAPHY, WILL DETERMINE THE ABSOLUTE SPATIAL ORIENTATION OF THE CAMERA. THE FRAME CAMERA WILL OPERATE WITH A FORWARD LAP OF 67 PERCENT. THE SYSTEM CONSISTS OF A 6-INCH FOCAL LENGTH (EFL=152 MM) METRIC CAMERA AND A STELLAR REFERENCE CAMERA, HAVING AN EFFECTIVE FOCAL LENGTH OF 250 TO 300 MM, RIGIDLY CONNECTED IN A POSITION WHICH PLACES ITS OPTICAL AXIS 15 DEG ABOVE THE HORIZON AND 45 DEG FROM THE DIRECTION OF FLIGHT DURING OPERATION. THE PRECISION METRIC LENS WILL BE EITHER OF THE TOPARON OR WIDE ANGLE TYPE, COLOR CORRECTED, WITH A MAXIMUM APERTURE OF AT LEAST F/5.6 AND SUFFICIENT FIELD ANGLE TO COVER THE 23 X 23 CM FORMAT. SYSTEM RESOLUTION OF 40-50 LINES/MM WILL BE OBTAINED WITH THE GROUND IMAGE SCALE BEING 1:1,700,000. CALIBRATION PHOTOGRAPHY, AT THE BEGINNING AND END OF THE OVERALL MISSION, WILL BE OBTAINED BY MANEUVERING THE SPACECRAFT SUCH THAT BOTH CAMERAS CAN PHOTOGRAPH SIMULTANEOUSLY, THE FIELD OF THE FIXED STARS. BOTH CAMERAS WILL BE EQUIPPED WITH FILM CASSETTES, WHICH CAN BE REMOVED BY A GLOVED ASTRONAUT FOR RETURN.

32. PHENOMENA OBSERVED

SOLAR RADIATION REFLECTED FROM THE SURFACE OF THE EARTH

33. MEASUREMENT RANGE

34. PRECISION AND ACCURACY

PREDICTED ACCURACY OF GEODETIC CONTROL OF +- 40 METERS

35. SPECTRAL RESOLUTION			36. TIME CONSTANT
0.4	TO	0.7 MICRON	NA

37. FIELD OF VIEW	38. GROUND SWATH
95.0 BY 95.0 DEG	300 NM BY 300 NM FROM 140 NM ALTITUDE

39. RESOLUTION
0.01 DEG 40-50 LINES/MM = 150-200 FEET FROM 140 NM ALTITUDE

40. POINTING ERROR	41. POINTING RATE	42. ALTITUDE	43. INCLINATION
1.5 DEG	0.05 DEG/SEC	LOW CIRCULAR	MEDIUM POSIGRADE

40. SPECIAL REQUIREMENTS

EXPOSURE TIME, S/C TIME, AND UNIVERSAL TIME MUST BE RECORDED

43. [illegible]

METRIC CAMERA, STELLAR CAMERA, RECORDING AND CONTROL EQUIPMENT

44. WEIGHT	45. VOLUME	46. AVERAGE POWER	47. STANDBY POWER	52. PEAK POWER	53. MTBF
200 LB	12.5 CU FT	250 WATTS	NONE	400 WATTS	

48. [illegible]	49. [illegible]	50. NUCLEAR INTERFERENCE	51. THERMAL INTERFERENCE	58. SHIELDING
		SENSITIVE		

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
START + END OF SEQUENCE	MANNED RETURN	AS PROGRAMMED

62. [illegible] REQUIREMENTS

UP AND DOWN LINK COMMUNICATION NECESSARY TO UPDATE SITE SELECTION PLAN.

64. ADVANTAGES AND LIMITATIONS

DATA STORED ON FILM AT S/C MUST BE RETURNED TO EARTH

66. REFERENCES

1) NASA EXPERIMENT IMPLEMENTATION PLAN FOR MANNED SPACE FLIGHT EXPERIMENTS-METRIC CAMERA (SPECIAL). OCTOBER 30, 1967.

65. HISTORICAL REMARKS

DUE TO DELAY IN AAP APPROVAL, INSTR DEVELOPMENT WAS NOT FUNDED

76. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
MICROWAVE TEMPERATURE-SOUNDING EXPERIMENT	MTS	S104
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0003

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
STAELIN, D.H.	MIT	617-864-6900-X3711
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
NA	NA	NA	NA	INACT	PROPOSAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
TERWILLIGER, R.G.	NASA HDQTRS	OSSA/SRB	202-962-0574

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
JET PROPULSION LAB	PASADENA, CALIFORNIA	NA	18 MONTHS

26. INSTRUMENT TYPE (REQMT'S)

RADIOMETER, 5-MILLIMETER DICKE-SUPERHETERODYNE MICROWAVE UNC

28. APPLICATION	29. SPACECRAFT
MET	APOLLO APPLICATIONS

30. PURPOSE

PRIMARY-TO DEMONSTRATE THE CAPABILITIES AND LIMITATIONS OF MICROWAVE SENSORS FOR MEASURING ATMOSPHERIC TEMPERATURE PROFILES IN THE ATMOSPHERE, EVEN IN THE PRESENCE OF MANY CLOUD TYPES WHICH BLOCK INFRARED SENSORS.

31. PRINCIPLES OF OPERATION

THE INSTRUMENT CONSISTS OF A SINGLE PACKAGE CONTAINING 2 COMPLETE AND INDEPENDENT RADIOMETERS OF THE DICKE TYPE IN A SUPERHETERODYNE CONFIGURATION OPERATING NEAR 53.5 AND 55.0 GHZ. TOTAL BANDWIDTH AT EACH FREQUENCY IS 200 MHZ. EACH RADIOMETER CONSISTS OF A SMALL FEED HORN, CALIBRATION CIRCUITRY, R.F. COMPONENTS, LOCAL OSCILLATOR-MIXER-I.F. PREAMPLIFIER, I.F. AND VIDEO CIRCUITRY, DATA INTERFACE CIRCUITRY, AND POWER SUPPLIES. THE PACKAGE IS ORIENTED SUCH THAT THE FEED HORNS HAVE AN UNOBSTRUCTED VIEW OF NADIR. THE OUTPUT SIGNALS WILL BE SAMPLED ONCE EVERY 5 SEC, AND THIS DATA PLUS THE TIME WILL BE RECORDED FOR LATER TELEMETRY TO THE GROUND. THE ANTENNA BEAMWIDTHS WILL BE APPROXIMATELY 20 DEG WITH STRONG SIDELOBE SUPPRESSION. THE RADIOMETER BASELINE AND GAIN WILL BE CALIBRATED AUTOMATICALLY USING INTERNAL CALIBRATION LOADS. WHILE THE ANTENNA TEMPERATURES ARE EXPECTED TO BE 250-290 K AT 53.5 GHZ AND 210-250 K AT 55.0 GHZ, THE DYNAMIC RANGE WILL BE LARGER TO ACCOMODATE THE CALIBRATION SIGNALS. THE SENSITIVITY AT EACH FREQUENCY WILL BE 1 K. THE TWO FREQUENCIES ARE MOST SENSITIVE TO TEMPERATURES AN HEIGHTS OF 4 AND 10 KM. TO CORRELATE DATA AN IR TEMPERATURE SOUNDER SHOULD BE PART OF THE INSTRUMENT COMPLEMENT.

32. PHENOMENA OBSERVED

THERMAL RADIATION AT 5.5 MM AND 5.6 MM WAVELENGTHS

33. MEASUREMENT RANGE

150 TO 400 DEG K

34. PRECISION AND ACCURACY

ABSOLUTE ACCURACY = APPROXIMATELY 1 DEG K

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
5.5 TO 5.6 MM	200. MHZ	

38. FIELD OF VIEW	39. GROUND SWATH
20. DEG	50 NM DIAM CIRCLE FROM 140 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
NA	NA

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
1.0 DEG	1.0 DEG/SEC	LOW CIRCULAR	MEDIUM POSIGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

2 RADIOMETERS WITH COMPONENTS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
50 LB	2. CU FT	30 WATT	NONE	30 WATT	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
SENSITIVE				

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
SEE ITEM 31	DELAYED TELEMETRY	CONTINUOUS

62. TELEMETRY REQUIREMENTS

OUTPUT REQUIRES 10-BIT DIGITAL WORDS AND 12 DATA CHANNELS SAMPLED EVERY 5 SECONDS TOTALLING 24 BITS/SEC.

63. ADVANTAGES AND LIMITATIONS

MICROWAVE SENSORS LESS SENSITIVE TO CLOUDS THAN IR SENSORS

64. REFERENCES

1) EXPERIMENT IMPLEMENTATION PLAN FOR MANNED SPACE FLIGHT EXPERIMENTS - MICROWAVE TEMPERATURE SOUNDER (S104). NASA, OCT 30, 1967.

66. HISTORICAL REMARKS

THE ORIGINAL PROPOSAL WAS SUBMITTED FOR THE APOLLO APP 1A S/C

67. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE		2 ACRONYM	3. EXP NO
MILLIMETER-WAVE PROPAGATION EXPERIMENT		MWP	S041
(TITLE CONT.)		4. RESUME DATE	5
		11/10/69	0003

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
NICHOLS, G.B.	SOUTHERN RESEARCH INST	205-323-6592-X361
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
NA	NA	NA	NA	INACT	PROPOSAL

18. MONITOR	19. AGENCY	20 PGM OFFICE	21. TELEPHONE
TERWILLIGER, R.G.	NASA HDQTRS	OSSA/SRB	202-962-0574

22. VENDOR	23 LOCATION	24. FLIGHT DATE	25. LEAD TIME
		NA	

26. INSTRUMENT TYPE

TRANSMITTER, MILLIMETER WAVE 8 PHASE-LOCKED KLYSTRONS — UNC

28. APPLICATION	29. SPACECRAFT
MET	APOLLO APPLICATIONS

30. PURPOSE

PRIMARY-TO DETERMINE STATISTICALLY THE ATMOSPHERIC PROPAGATION PARAMETERS THAT ARE IMPORTANT FOR CHARACTERIZING WIDEBAND EARTH-SPACE COMMUNICATIONS PERFORMANCE AT 16 AND 35 GHZ.

31. PRINCIPLES OF OPERATION

ONBOARD THE SPACECRAFT TWO TRANSMITTERS, AT 16 GHZ AND 35 GHZ, WILL TRANSMIT SIGNALS TO RESPECTIVE GROUND STATIONS. BY MEASURING THE AMPLITUDE AND PHASE OF THE RECEIVED SIGNALS MILLIMETER WAVE PROPAGATION CHARACTERISTICS OF THE ATMOSPHERE WILL BE DETERMINED. THE TRANSMITTED SIGNALS ARE PRODUCED BY FOUR 16 GHZ AND FOUR 35 GHZ PHASE-LOCKED KLYSTRONS WHICH ARE SEPARATED IN FREQUENCY BY APPROXIMATELY 450 MHZ. THE ACTUAL OPERATING FREQUENCIES ARE AS FOLLOWS: THE 35 GHZ GROUP INCLUDES 34.457, 34.559, 34.639, AND 34.928 GHZ; THE 16-GHZ GROUP INCLUDES 15.883, 15.984, 16.065, 16.341 GHZ. THE MINIMUM DYNAMIC RANGE OF MEASURABLE ATMOSPHERIC ATTENUATION FOR THE 250 MILLIWATT 35 GHZ DOWNLINK IS 32 DB ASSUMING A RECIEVER NOISE FIGURE OF 12 DB AND A RECEIVER SIGNAL-TO-NOISE RATIO GREATER THAN 10 DB. THE DYNAMIC RANGE OF THE 16 GHZ SYSTEM WILL BE ABOUT 40 DB ASSUMING A 6 DB RECEIVER NOISE FIGURE AND 600 MILLIWATTS OF TRANSMITTED POWER. THE CARRIER SIGNAL AMPLITUDE CAN BE MEASURED TO WITHIN 0.2 DB. THERE IS A PHASE DIFFERENCE BETWEEN CARRIER AND SIDEBAND OF 7 DEG. THE ATTENUATION IS EXPECTED TO BE FROM 15 DB (HEAVY RAIN AND S/C AT 5 DEG ELEV) TO 0.1 DB (CLEAR WEATHER AND S/C AT ZENITH). THE TRANSMITTED BEAMWIDTH IS 20 DEG.

32. PHENOMENA OBSERVED

MILLIMETER WAVE TRANSMISSIONS FROM SATELLITES

33. MEASUREMENT RANGE

32 DB FOR 35 GHZ AND 40 DB FOR 16 GHZ

34. PRECISION AND ACCURACY

AMPLITUDE TO PLUS OR MINUS 0.2 DB

CONSTANT

16.0 TO 35.0 GHZ NA

20.0 DEG 70 NM DIAM CIRCLE FROM 200 NM ALTITUDE

20.0 DEG 70 NM FROM 200 NM ALTITUDE

2.0 DEG 0.5 DEG/SEC LOW CIRCULAR MEDIUM POSIGRADE

ACTIVE COOLING OF TRANSMITTER REQUIRED

8 KLYSTRON TRANSMITTERS

TYPE

200 LB 4.2 CU FT 235 WATTS 270 WATTS

SOURC/SEN

OVER GROUND SITES REALTIME TELEMETRY AS PROGRAMMED

NO SCIENTIFIC DATA RECORDED ON-BOARD. TEN CHANNELS OF 8 BITS/WORD, 0.1 SAMPLE/SEC. A 20 DEG BEAMWIDTH SIGNAL IS TO BE USED. EXPERIMENT HOUSEKEEPING DATA ARE REQUIRED.

36. ADVANTAGES AND LIMITATIONS

36. REFERENCES

1) NASA APPLICATIONS A AND B PHASE B INTEGRATION STUDY DOCUMENT. NASA/MSC, APR 1967.***2) MINZNER, R.A.(ED): INTERIM REPORT ON SATELLITE METEOROLOGICAL INSTRUMENTS. NASA/ERC PM-6713, JUNE 8, 1967.

35. HISTORICAL REMARKS

DUE TO DELAY IN AAP APPROVAL, INSTR DEVELOPMENT WAS NOT FUNDED

39. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
MOLECULAR-OXYGEN MICROWAVE-EMISSION RADIOMETER	MOMER	S076
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
LENOIR, DR. W.B.	MANNED SPACECRAFT CENTER	713-483-2221
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
BARATH, F.T.	JET PROPULSION LAB	213-354-3025

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
NA	NA	NA	NA	INACT	PROPOSAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
TERWILLIGER, R.G.	NASA HDQTRS	OSSA/SRB	202-962-0574

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
NA	NA	NA	

26. INSTRUMENT TYPE	27. SECURITY
RADIOMETER, 5-CHANNEL MICROWAVE DICKE	PRO

28. APPLICATION	29. SPACECRAFT
MET, ERSP	APOLLO APPLICATIONS

30. PURPOSE

PRIMARY - TO DETERMINE THE TEMPERATURE PROFILE OF THE ATMOSPHERE UP TO A HEIGHT OF 75-80 KM BY MEASURING THE MICROWAVE EMISSION DUE TO MOLECULAR-OXYGEN RESONANCE. WHEN CORRELATED WITH THE RESULTS OF THE WATER-VAPOR-RESONANCE MICROWAVE-EMISSION RADIOMETER EXPERIMENT (AAP, WVRMER, S077), TEMPERATURE PROFILES DOWN TO THE EARTH'S SURFACE MAY BE CALCULATED.

31. PRINCIPLES OF OPERATION

THE INSTRUMENT CONSISTS OF A 5-CHANNEL DICKE RADIOMETER, TWO LOCAL OSCILLATORS AND A 10-INCH PARABOLOID ANTENNA WITH HALF-POWER BEAM WIDTH OF 5-10 DEG. THE INSTRUMENT OPERATES CONTINUOUSLY, VIEWING THE NADIR EXCEPT FOR INFREQUENT CALIBRATION ROLLS (1-4 PER DAY) TO VIEW SPACE. THE INTENSITY OF MICROWAVE RADIATION OR BRIGHTNESS TEMPERATURE IS MEASURED IN FIVE NARROW SPECTRAL BANDS NEAR 60 GHZ (5 MM WAVELENGTH). ONE SPECTRAL BAND IS CENTERED ON A MAGNETICALLY-SPLIT RESONANCE LINE, TWO ARE BETWEEN RESONANCE LINES AND TWO ARE ON THE WINGS OF A STRONG LINE. THESE BANDS RESPOND TO RADIATION MAINLY FROM 3 REGIONS, THE TROPOPAUSE (15-20 KM), THE STRATOPAUSE (45-55 KM) AND THE MESOSPHERE (62-84 KM). THE NADIR BRIGHTNESS TEMPERATURES ARE DERIVED FROM ANTENNA TEMPERATURE MEASUREMENTS THROUGH USE OF THE PRE-MEASURED ANTENNA PATTERN AND THE CALIBRATION DATA. THEN MATHEMATICAL INVERSION TECHNIQUES ARE USED TO INFER AN ATMOSPHERIC TEMPERATURE PROFILE. THE VERTICAL RESOLUTION IS ABOUT 16 KM IN THE MESOSPHERE. THE RADIATION COMES FROM A COLUMN OF AIR WHOSE SURFACE PROJECTION IS 65 KM NORMAL TO THE S/C GROUNDTRACK AND IS EITHER 65 KM OR 130 KM ALONG THE TRACK--DEPENDING UPON WHETHER THE INTEGRATION TIME IS 10 OR 25 SECONDS.

32. PHENOMENA OBSERVED

MICROWAVE RADIATION EMITTED FROM THE EARTH'S SURFACE/ATMOSPHERE

33. MEASUREMENT RANGE

EXPECTED RANGE OF BRIGHTNESS TEMPERATURE = ZERO TO 400 DEG K

34. PRECISION AND ACCURACY

BRIGHTNESS TEMPERATURE MEASURED TO WITHIN 2 TO 4 KELVIN DEGREES.

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
60. GHZ		

38. FIELD OF VIEW	39. GROUND SWATH
+-30. DEG SEE ITEM 31	

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
+-5. DEG	SEE ITEM 31

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
2.0 DEG		LOW CIRCULAR MEDIUM	POSIGRADE

46. SPECIAL REQUIREMENTS

OPERATED IN CONJUNCTION WITH S075 AND S077; SUPPORT PHOTOS REQ'D

47. COMPONENTS

RADIOMETER, 2 LOCAL OSCILLATORS, ONE ANTENNA, AND ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
30 LB	2.0 CU FT	107 WATTS		143 WATTS	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
SEE ITEM 31	DELAYED TELEMETRY	CONTINUOUS

62. TELEMETRY REQUIREMENTS

FIVE SCIENCE OUTPUTS, EACH SAMPLED TWICE PER SECOND WITH 10 BIT ACCURACY; 10 ENGINEERING OUTPUTS, EACH SAMPLED ONCE EVERY 10 SEC WITH 8 BIT ACCURACY. TOTAL OF 108 BITS/SEC.

63. ADVANTAGES AND LIMITATIONS

LIGHT TO MEDIUM CLOUDS WILL NOT AFFECT THE RESULTS AS THEY WOULD FOR IR SOUNDINGS.

64. REFERENCES

1) NASA APPLICATIONS A AND B PHASE B STUDY DOCUMENT. NASA/MSC APRIL 1967.***2) MINZNER, R.A. ED.: INTERIM REPORT ON SATELLITE METEOROLOGICAL INSTRUMENTS, PM-6713. NASA/ERC, JUNE 1967.

65. HISTORICAL REMARKS

REVISED VERSION OF AN EXPERIMENT (S044B) PROPOSED FOR AAP A.

66. DIAGRAMS

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
CAMBRIDGE, MASSACHUSETTS

1 TITLE	2 ACRONYM	3 EXPERIMENT NO.
MULTIBAND SYNOPTIC PHOTOGRAPHY EXPERIMENT	MBSP	S042
(TITLE CONT.)	4. RESUME DATE	5. REV. NO.
	11/10/69	0003

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
SLATER, DR. P.N.	UNIVERSITY OF ARIZONA	602-884-3136
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH BADLY NUMBER	15. START DATE	16. STATION USE	17. STATUS
NA	NA	NA	NA	INACT	PROPOSAL

18. MONITOR	19. AGENCY	20. FOM OFFICE	21. TELEPHONE
TERWILLIGER, R.G.	NASA HDQTRS	OSSA/SRB	202-962-0574

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
		NA	

26. INSTRUMENT TYPE (27. SERIAL #)

IMAGER, 5 METRIC 6-INCH VISIBLE-UV CAMERAS

28. APPLICATION | 29. SPACECRAFT

ERSP, MET | APOLLO APPLICATIONS

30. PURPOSE

PRIMARY-TO OBTAIN MULTI-SPECTRAL SYNOPTIC STEREOSCOPIC COVERAGE OVER A SELECTED PORTION OF THE EARTH'S SURFACE FOR THE IDENTIFICATION AND DISCRIMINATION OF SURFACE FEATURES AND CHARACTERISTICS.***SECONDARY-TO PROVIDE DATA FOR CORRELATION WITH DATA OBTAINED BY OTHER REMOTE-SENSOR EXPERIMENTS, SUCH AS IR, RADAR, MICROWAVE, AND UV INSTRUMENTATION.

31. PRINCIPLES OF OPERATION

THIS SYSTEM CONSISTS OF 5 MATCHED 6-INCH FOCAL LENGTH METRIC CAMERAS (FRAME) AND A SMALLER UV CAMERA BORESIGHTED AND SYNCHRONIZED. EACH METRIC CAMERA LENS WILL BE FOCUSED AT INFINITY WITH 74 DEGREES ANGULAR COVERAGE (ACROSS FLATS) AND FULLY COLOR-CORRECTED OVER A SPECTRAL RANGE OF 4000 TO 10,000 A. THE EFFECTIVE SHUTTER-SPEED RANGE IS VARIABLE FROM 1/10 TO 1/500 OF A SECOND WITH AN APERTURE CONTROL RANGE FROM F/4.5 TO F/22. FILM FORMAT IS 9 X 9 INCHES. EACH FRAME COVERS A 188 X 188 NM AREA FROM 125 NM ALTITUDE. THE MINIMUM EFFECTIVE RESOLVING POWER OF THE METRIC CAMERAS WILL GIVE A GROUND RESOLUTION OF 30 METERS. THE UV CAMERA (A MAURER) WILL HAVE A QUARTZ/LITHIUM-FLOURIDE LENS WITH A 40 DEG FOV AND WILL USE 70 MM FILM. THE FRAME RATE WILL BE VARIABLE TO PERMIT A MINIMUM OF 10 PER CENT TO A MAXIMUM OF 67 PERCENT OVERLAP ON ADJACENT PHOTOGRAPHS. THE CAMERAS WILL BE FULLY AUTOMATIC AND PRE-PROGRAMMED BUT WILL HAVE PROVISIONS FOR MANUAL OVERRIDE. THREE FILM TYPES WILL BE USED: (1) PANCHROMATIC-4000 TO 7000 A; (2) NEAR INFRARED-7000 TO 10,000 A; (3) NEAR UV-2700 TO 4000 A. FILTERS USED WILL BE BROAD BAND (500 A TO 1500 A) WITH A SHARP CUTOFF AND HIGH-TRANSMISSION CHARACTERISTICS.

32. PHENOMENA OBSERVED

REFLECTED ENERGY FROM EARTH'S SURFACE AT SPECIFIC WAVELENGTHS

33. MEASUREMENT RANGE

34. PRECISION AND ACCURACY

REFLECTED INTENSITY, 5 PCT; REGISTRATION, 0.5 RESOL ELEMENT

35. SPECTRAL RESOLUTION | 36. SPECTRAL RESOLUTION | 37. TIME CONSTANT

0.27 TO 1.0 MICRONS | 1.0 MICRON

39. GROUND SWATH

74.0 BY 74.0 DEG | 188 NM BY 188 NM FROM 125 NM ALTITUDE

41. SPATIAL RESOLUTION

0.007 DEG | 100 FEET FROM 125 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
0.5 DEG	0.03 DEG/SEC	LOW CIRCULAR	MEDIUM POSIGRADE

46. SPECIAL REQUIREMENTS

THE LENS SURFACES MUST BE MAINTAINED COMPLETELY CLEAN.

47. COMPONENTS

6 CAMERAS, CALIBRATION DEVICE, CONTROL SYSTEM

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
1400 LB	62. CU FT	900 WATTS		1340 WATTS	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
SENSITIVE				

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
GRAY SCALE ON FILM	MANNED RETURN	ON COMMAND

62. TELEMETRY REQUIREMENTS

HOUSEKEEPING DATA WILL BE REQUIRED IN THE FORM OF 36 CHANNELS OF 8 BITS/WORD, SAMPLED 6 TIMES PER MINUTE. VOICE CONTACT WITH CREW IS ALSO REQUIRED.

63. ADVANTAGES AND LIMITATIONS

GREAT AMOUNT OF SPECIFIC DATA AVAILABLE DUE TO SPECTRAL SELECTIVITY CAPABILITIES.

64. REFERENCES

1) APPLICATIONS B,PHASE B INTEGRATION STUDY DOCUMENT, NASA/MSC APRIL 1967.***2) PROPOSAL FOR A MULTIBAND SYNOPTIC PHOTOGRAPHIC EXPERIMENT FOR MANNED EARTH ORBITAL MISSIONS,NASA/OSSA,JUNE 10, 1966.***3) MINZNER, R.A. (ED): INTERIM REPORT ON SATELLITE METEOROLOGICAL INSTRUMENTS, PM-6713. NASA/ERC, JUNE 8, 1967.

65. HISTORICAL REMARKS

DUE TO DELAY IN AAP APPROVAL, INSTR DEVELOPMENT WAS NOT FUNDED

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
MULTICHANNEL RADIOMETER	MCR	S057
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0003

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
REA, DR. D. G.	NASA HEADQUARTERS	202-962-5468
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
COLWELL, DR. R.	UNIV OF CALIF, BERKELEY	415-845-6000-X1351

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
NA	NA	NA	NA	INACT	PROPOSAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
CENTERS, C.D.	NASA HDQTRS	OSSA/SRB	202-962-0574

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
		NA	

26. INSTRUMENT TYPE — 27. STATUS: PRO

RADIOMETER, 3-CHANNEL TELESCOPIC IR/VISIBLE SCANNING

28. APPLICATION	29. SPACECRAFT
ERSP, MET	APOLLO APPLICATIONS

30. PURPOSE

PRIMARY-TO PROVIDE INFORMATION ON THE NATURE OF THE EARTH'S SURFACE AND ON PARTICULATE MATTER IN THE ATMOSPHERE.***SECONDARY-TO TEST PRESENT THEORIES OF RAYLEIGH AND MIE SCATTERING.*** TERTIARY-TO MAP CLOUDS, ESTIMATE THEIR HEIGHT, AND GIVE SURFACE THERMAL PROPERTIES DURING BOTH DAY AND NIGHT.

31. PRINCIPLES OF OPERATION

THE INSTRUMENT CONSISTS OF A 6-INCH, F/2, CASSEGRAIN TELESCOPE WITH AN IMAGE DISSECTOR IN THE FOCAL PLANE TO DIRECT RADIATION INTO 3 CHANNELS. TUNING FORKS (F=800 HZ) CHOP EACH BEAM. CHANNELS 1 AND 2 MEASURE THE INTENSITY OF REFLECTED SOLAR RADIATION. FILTERS LIMIT CHANNEL 1 TO 6.3 TO 6.5 MICRONS, AND CHANNEL 2 TO 7.9 TO 8.1 MICRONS.THE FILTER FOR CHANNEL 3 PASSES EARTH-EMITTED RADIATION IN THE 10-11 MICRON RANGE. POLAROID DISKS ROTATING AT 111 RPS DETERMINE POLARIZATIONS OF THE BEAMS IN CHANNELS 1 AND 2. AN OSCILLATING MIRROR PLACED IN FRONT OF THE TELESCOPE AT 45 DEG TO THE AXIS SCANS THE SCENE NORMAL TO THE S/C GROUND TRACK. THE SCAN SPEED AND AMPLITUDE ARE CHOSEN SO THAT ADJACENT STRIPS ARE CONTIGUOUS, AND A TWO-DIMENSIONAL IMAGE CAN BE CONSTRUCTED. THE DETECTORS ARE 20-ELEMENT LINEAR ARRAYS, SILICON FOR CHANNELS 1 AND 2 AND THERMISTORS FOR CHANNEL 3. PREFLIGHT CALIBRATIONS FOR THE FIRST TWO CHANNELS ARE USED DURING DATA REDUCTION. A LOOK AT SPACE FOR A ZERO AND AT A HONEYCOMB BLACKBODY FOR A HIGH TEMPERATURE CALIBRATION ARE TAKEN FOR THE 3RD CHANNEL. INTENSITIES ARE MEASURED TO 0.5 PERCENT OF THE MAXIMUM SIGNAL. A FOUR-STEP AUTOMATIC GAIN CONTROL AVERAGES THE BRIGHTNESS OF A SET OF 200 SCANS AND SETS THE GAIN ACCORDINGLY.

32. PHENOMENA OBSERVED

INTENSITY/POLARIZATION OF REFLECTED SOLAR AND EMITED RADIATION

33. MEASUREMENT RANGE

ALBEDO 0 TO 0.85; POLARIZATION 0 TO 0.40; TEMP 200 TO 300 DEG K

34. PRECISION AND ACCURACY

ALBEDO AND POLARIZATION WITHIN 0.01; BRIGHTNESS TEMP +- 1 DEG K

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.63 TO 11.0 MICRONS	NA	

38. FIELD OF VIEW	39. GROUND SWATH
8.0 BY 2.3 DEG	28 NM BY 8 NM FROM 200 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.11 DEG	0.4 NM FROM 200 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
0.6 DEG	0.1 DEG/SEC	LOW CIRCULAR	MEDIUM POSIGRADE

46. SPECIAL REQUIREMENTS

RAWINSONDES REQUIRED, SIMULTANEOUS PHOTOGRAPHY REQUIRED (S042)

47. COMPONENTS

3-CHANNEL RADIOMETER, OPTICS, ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
18 LB	0.8 CU FT	14 WATTS		19 WATTS	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
			SENSITIVE	TO BE DETERMINED

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
DURING DATA REDUCTION	DELAYED TELEMETRY	AS PROGRAMMED

62. TELEMETRY REQUIREMENTS

TOTAL DATA RATE IS 25.6 KILOBITS PER SECOND

63. ADVANTAGES AND LIMITATIONS

THE USE OF AN IMAGE DISSECTOR PERMITS EVERY CHANNEL TO HAVE COMPLETE ACCESS TO THE FULL APERTURE OF THE TELESCOPE.

64. REFERENCES

1) NASA APPLICATIONS A AND B PHASE B INTEGRATION STUDY DOCUMENT. NASA/MSC, APRIL 1967.***2) REA, D.G.;R. COLWELL, AND K. COULSON: PROPOSAL FOR A 3-CHANNEL RADIOMETER FOR THE APOLLO SPACECRAFT. U. OF CALIF., BERKELEY, MAR 66.

68. HISTORICAL REMARKS

DUE TO DELAY IN AAP APPROVAL, INSTR DEVELOPMENT WAS NOT FUNDED.

69. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
MULTISPECTRAL TERRAIN PHOTOGRAPHY EXPERIMENT	MTP	S101
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
SLATER, DR. P.N.	UNIVERSITY OF ARIZONA	602-884-3136
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
					PROTOTYPE

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
TERWILLIGER, R.G.	NASA HDQTRS	OSSA/SRB	202-962-0574

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
HASSELBLAD			18 MONTHS

26. INSTRUMENT TYPE	27. BEGIN/UNC
IMAGER, VISIBLE HASSELBLAD 500-EL FRAME-CAMERA	UNC

28. APPLICATION	29. SPACECRAFT
ERSP, MET	APOLLO APPLICATIONS

30. PURPOSE

PRIMARY-TO OBTAIN MULTISPECTRAL COVERAGE OVER A SELECTED PORTION OF THE EARTH'S SURFACE FOR THE IDENTIFICATION AND DISCRIMINATION OF SURFACE FEATURES AND CHARACTERISTICS AND TO OBTAIN PHOTOGRAPHY FOR APPLICATIONS ALREADY DEMONSTRATED.***SECONDARY-TO PROVIDE DATA FOR CORRELATION WITH AN INTERPRETATION OF RESULTS OF OTHER REMOTE SENSORS.

31. PRINCIPLES OF OPERATION

THE SYSTEM CONSISTS OF SIX MATCHED CAMERAS BORESIGHTED AND SYNCHRONIZED TO EACH OTHER AND TO OTHER SENSORS IN THE SPACECRAFT SYSTEM AS REQUIRED BY THE MISSION. THE CAMERAS ARE HASSELBLAD 500 EL (FRAME) CAMERAS WITH 120 MM FOCAL LENGTH LENSES. THE FILM AND FILTERS PROVIDE SPECTRAL DATA FROM ABOUT 0.3 MICRON TO ABOUT 1.0 MICRON. THE FILTERS ARE BROAD BAND (500 A TO 1500 A WIDE) WITH SHARP CUTOFF AND HIGH TRANSMISSION CHARACTERISTICS (GREATER THAN 90 PERCENT AT MAXIMUM TRANSMISSION). FILTERS ARE EITHER OPTICAL FLATS OR PRECISION MENISCUS SHAPES AND ARE PERMANENTLY INSTALLED PRIOR TO FLIGHT TIME. THE SHUTTER IS OF THE INTRA-LENS, HIGH-EFFICIENCY TYPE WITH AN EFFECTIVE SPEED RANGE FROM 1/10 TO 1/500 OF A SECOND. A VARIABLE CYCLING RATE PERMITS A MINIMUM OF 10 PERCENT OVERLAP ON ADJACENT PHOTOGRAPHS. THE SHUTTERS OF THE SIX CAMERAS ARE PROGRAMMED AND SYNCHRONIZED BY A CENTRAL CONTROL SYSTEM. APERTURE CONTROL RANGE IS FROM F/4.5 TO F/22 AND WILL BE CAPABLE OF AUTOMATIC CONTROL. AN IMAGE IS STORED IN A 58 MM BY 58 MM FORMAT ON 70 MM FILM. FILMS TO BE USED INCLUDE PANCHROMATIC (4000 TO 7000 A), NEAR INFRARED (0.7 TO 1 MICRON), COLOR, AND COLOR IR.

32. PHENOMENA OBSERVED

REFLECTED SOLAR RADIATION FROM THE SURFACE OF THE EARTH

33. MEASUREMENT RANGE

ADJUSTS FOR AVERAGE SCENE BRIGHTNESS UP TO A FACTOR OF 1200

34. PRECISION AND ACCURACY

36. SPECTRAL RANGE | 37. SPECTRAL RESOLUTION / RADIOMETRIC CONSTANT

0.3 TO 1.0 MICRON SEE ITEM 31

38. FIELD OF VIEW | 39. GROUND SWATH

27.0 BY 27.0 DEG; 60 NM BY 60 NM FROM 125 NM ALTITUDE

40. ANGULAR RESOLUTION / SPATIAL RESOLUTION

0.008 DEG; 30 METERS (100 FEET) FROM 125 NM ALTITUDE

42. POINTING ACCURACY | 43. POINTING RATE | 44. ALTITUDE | 45. INCLINATION

1.5 DEG .03 DEG/SEC; LOW CIRCULAR MEDIUM POSIGRADE

46. SPECIAL REQUIREMENTS

S/C WINDOW WITH HIGH SPECTRAL TRANSMISSION FROM 0.3 TO 1 MICRON

47. COMPONENTS

6 CAMERAS, 18 MAGAZINES, CONTROLS

48. WEIGHT | 49. VOLUME | 50. AVERAGE POWER | 51. STANDBY DATA | 52. PEAK POWER | 53. MTBF

55 LB 1.0 CU FT NONE NONE NONE

54. RF INTERFERENCE | 55. MAGNETIC INTERFERENCE | 56. NUCLEAR INTERFERENCE | 57. THERMAL INTERFERENCE | 58. SHIELDING

59. CALIBRATION | 60. DATA RECOVERY | 61. FREQUENCY OF OBSERVATION

PRE- AND POST-FLIGHT MANNED RETURN ON COMMAND

62. TELEMETRY REQUIREMENTS

REAL TIME VOICE COMMUNICATIONS ARE DESIRED TO RELAY DATA ON FILM USAGE, TARGET CONDITIONS, WEATHER, AND SO FORTH.

63. ADVANTAGES AND LIMITATIONS

64. REFERENCES

1) NASA-EXPERIMENT IMPLEMENTATION PLAN FOR MULTISPECTRAL PHOTOGRAPHY/(S101), OCT. 1967.

65. HISTORICAL REMARKS

THIS EXP IS SIMILAR TO S065 WHICH WAS FLOWN ON APOLLO 9.

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
RADAR ALTIMETER/SCATTEROMETER	RADAS	S105
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
MOORE, DR. R.K.	UNIVERSITY OF KANSAS	913-864-3441
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
NA	NA	NA	NA	INACT	PROPOSAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
CENTERS, C.D.	NASA HDQTRS	OSSA/SRB	202-962-0574

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
NA	NA	NA	NA

26. INSTRUMENT TYPE	27. SECURITY
ALTIMETER/SCATTEROMETER, RADAR PULSE SYSTEM FAN BEAM ANTENNA	UNC

28. APPLICATION	29. SPACECRAFT
OCEAN, GEOL, CART	APOLLO APPLICATIONS

30. PURPOSE

PRIMARY-TO PROVIDE RADAR-ALTIMETER-SCATTEROMETER DATA OF THE EARTH FROM ORBITAL ALTITUDES FOR THE STUDY OF EARTH RESOURCES. ***SECONDARY-TO PROVIDE A BASIS FOR THE DESIGN OF SUCCEEDING EARTH ORBITAL RADAR SYSTEMS AND EXPERIMENTS.

31. PRINCIPLES OF OPERATION

THIS EXPERIMENT USES A COMBINED RADAR-ALTIMETER-SCATTEROMETER, UTILIZING A PULSE SYSTEM, A FAN BEAM ANTENNA, AND SCATTEROMETER GATING OF THE RETURN PULSE. THE FAN BEAM ANTENNA POINTS AHEAD OF OR BEHIND THE SPACECRAFT ALONG THE GROUND TRACK; THE ILLUMINATED AREA ON THE GROUND IS NARROW IN CROSSTRACK DIRECTION, AND EXTENDS FROM THE SUBSATELLITE POINT OUT TO A DISTANCE CORRESPONDING TO AN INCIDENT ANGLE OF 30 DEG. THE INITIAL GROUND RETURN IS USED BOTH FOR ALTIMETRY AND FOR MEASURING SCATTERING COEFFICIENT AT AND NEAR THE VERTICAL. SUBSEQUENT GROUND RETURNS ARE FROM LONGER RANGES AND THEREFORE ARE FROM GROUND PATCHES ILLUMINATED AT DIFFERENT ANGLES OF INCIDENCE. BY SAMPLING THIS RETURN AT SELECTED POINTS, THE RELATION OF SCATTERING COEFFICIENT TO, ANGLE CAN BE ESTABLISHED FOR DIFFERENT OF THE CO2 LINES THUS REDUCING THE 712 INV CM CHANNEL WIDTH TO 6.6 INV CM, THE 697 CHANNEL WIDTH TO 2.2 INV CM, THE 675 CHANNEL WIDTH TO 4 INV CM AND A 668 CHANNEL WIDTH TO 1.6 INV CM. THE USE IN OVERLAND EXPERIMENTS A SECOND MODE FOR THE ALTIMETER IS NECESSARY SO THAT IT MAY TRACK THE MORE RAPID VARIATIONS OF THUS THE BANDWIDTH IS NARROWED TO 1.0 INV CM FOR ONE CHANNEL AND 0.83 INV CM FOR THE OTHER. THE DETECTORS ARE THERMISTOR

32. PHENOMENA OBSERVED

RETURN OF SPACECRAFT-EMITTED RADAR PULSES

33. MEASUREMENT RANGE

34. PRECISION AND ACCURACY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.4 TO 8.0 GHZ		

38. FIELD OF VIEW	39. GROUND SWATH

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		LOW CIRCULAR MEDIUM	POSIGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

2 TRANSMITTER/RECEIVERS, 2 ANTENNAS, POWER SUPPLY, CONTROL PANEL

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
SOURC/SEN				

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
AUTOMATIC AND INTERNAL	MANNED RETURN	SPECIFIC AREAS

62. TELEMETRY REQUIREMENTS

63. ADVANTAGES AND LIMITATIONS

64. REFERENCES

1) NASA EXP. IMPLEMENTATION PLAN FOR A RADAR ALTIMETER/SCATTEROMETER FOR MANNED SPACEFLIGHT. OCT 67.***2) APP A AND B PHASE B INTERGRATION STUDY DOCUMENT. NASA/MSC, APR 67.***3) MOORE, R.K.E AL.: PROPOSAL FOR A RADAR ALTIMETER/SCATTEROMETER TO STUDY THE EARTH'S SURFACE. U KANSAS, 1965.

65. HISTORICAL REMARKS

THIS RESUME IS PURPOSELY GENERALIZED DUE TO THE INACTIVE STATUS

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
RADAR IMAGER	RADIM	S106
(TITLE CONT.)	4. RESUME DATE	5. VER
	11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
MOORE, DR. R.K.	UNIVERSITY OF KANSAS	913-864-3441
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
ELLERMEIER, DR. R.D.	UNIVERSITY OF KANSAS	913-864-3441

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
NA	NA	NA	NA	INACT	PROPOSAL

18. MONITOR	19. AGENCY	20. POI OFFICE	21. TELEPHONE
CENTERS, C.D.	NASA HDQTRS	OSSA/SRB	202-962-0574

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
NSR 17-004-003		NA	

26. INSTRUMENT TYPE — 27. ACRONYM

IMAGER, SIDE-LOOKING RADAR SYNTHETIC APERTURE PHASE COHERENT — UNC

28. APPLICATION

ERSP

29. SPACECRAFT

APOLLO APPLICATIONS

30. PURPOSE

PRIMARY-TO SPACE-QUALIFY THE RADAR IMAGER AT ORBITER ALTITUDES ***SECONDARY-TO PROVIDE INITIAL DATA FOR THE STUDY OF EARTH RESOURCES FROM SPACE. TO PROVIDE A BASIS FOR THE DESIGN OF SUCCEEDING EARTH-ORBIRAL RADAR IMAGING EQUIPMENT AND EXPERIMENTS.

31. PRINCIPLES OF OPERATION

A REPRESENTATIVE SIDE-LOOKING RADAR IMAGER CONSISTS OF 2 TRANSMITTER/RECEIVERS, 2 ANTENNAS, AND ASSOCIATED EQUIPMENT. THE SYSTEM EMITS A CONTINUOUS SERIES OF PULSES OF MICROWAVE FREQUENCIES IN THE X BAND (AROUND 3 CM), S BAND (AROUND 15 CM) AND X BAND (AROUND 70 CM). THE SYSTEM WOULD BE COHERENT AND UTILIZE A SYNTHETIC-APERTURE ANTENNA OF THE UNFOCUSSED TYPE WITH RADIATED BURSTS ILLUMINATING AN AREA OFF TO ONE SIDE OF THE SPACECRAFT'S GROUND TRACK (SIDE-LOOKING) ANTENNA POINTING ANGLE WOULD NOMINALLY BE 30 DEG FROM THE NADIR WITH THE ANTENNA RIGIDLY MOUNTED TO THE EXPERIMENT PLATFORM. EACH ANTENNA WOULD CONSIST OF A SLOTTED ARRAY MADE UP OF A NUMBER OF ELEMENTS, EACH ELEMENTS BEING A PIECE OF RECTANGULAR WAVE GUIDE SLOTTED FOR RECEIVING AND SENDING VERTICAL POLARIZATION IN ONE ANTENNA AND HORIZONTAL POLARIZATION IN THE OTHER. BY STORING SEPARATELY THE REFLECTIONS RECEIVED AT DIFFERENT INTERVALS OF TIME AFTER THE BURST IS INITIATED, THE RETURNS COMING FROM DIFFERENT GROUND DISTANCES OUT TO THE SIDE CAN BE SEPARATED OUT. THE IMAGE SO RECORDED IS NOT DIRECTLY INTERPRETABLE BUT REQUIRES ADDITIONAL GROUND (SYNTHETIC APERTURE) PROCESSING TO PROVIDE A CONTINUOUS STRIP RADAR IMAGE.

32. PHENOMENA OBSERVED

RADAR RETURNS FROM THE EARTH'S SURFACE

33. MEASUREMENT RANGE

34. PRECISION AND ACCURACY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
3.0 TO 70. CM	NA	

38. [illegible] FIELD OF VIEW	39. GROUND SWATH
	40 KM

40. [illegible] SPATIAL RESOLUTION

150 M

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		LOW CIRCULAR	MEDIUM POSIGRADE

46. SPECIAL REQUIREMENTS

ANTENNA BEAMS MUST POINT UP 30 DEG IN DIR NORMAL TO S/C MOTION

47. COMPONENTS

2 TRANSMITTER/RECEIVERS, 2 ANTENNAS, POWER SUPPLY, FILM RECORDER

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
SOURC/SEN				

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
	FILM RETURN	ON COMMAND

62. TELEMETRY REQUIREMENTS

63. ADVANTAGES AND LIMITATIONS

RADAR HAS ALL-WEATHER CAPABILITIES.

64. REFERENCES

1) NASA EXP. IMPLEMENTATION PLAN FOR A RADAR IMAGER SYSTEM FOR MANNED SPACEFLIGHT. OCT 67.***2) APP A AND B PHASE B INTEGRATION STUDY DOCUMENT. NASA/MSC, APR 67.***3) MOORE, R.K.ET.AL: PROPOSAL FOR AN IMAGING RADAR FOR MANNED SPACECRAFT TO STUDY THE EARTH'S SURFACE. U KANSAS, 1966.***4) MOORE, R. ET.AL. POTENTIAL RESEARCH AND EARTH RESOURCES STUDIES WITH ORBITING RADAS. AIAA OCT. 1967

65. HISTORICAL REMARKS

RESUME IS PURPOSELY GENERALIZED DUE TO INACTIVE STATUS OF INSTR

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
SELECTIVE CHOPPER RADIOMETER	SCR	S060
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0003

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
HOUGHTON, DR.J. ALSO	OXFORD UNIVERSITY, ENG.	
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
SMITH,DR.D./JOINT PI	READING UNIVERSITY,ENG.	

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
NA	NA	NA	NA	INACT	PROPOSAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
TERWILLIGER, R.	NASA HDQTRS	OSSA/SAB	202-962-0574

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
		NA	

26. INSTRUMENT TYPE	27. SECUR CL
RADIOMETER, 3 DUAL-CHANNEL IR	UNC

28. APPLICATION	29. SPACECRAFT
MET	APOLLO APPLICATIONS

30. PURPOSE

PRIMARY-TO DETERMINE ON A GLOBAL SCALE THE THREE DIMENSIONAL TEMPERATURE STRUCTURE OF THE EARTH'S ATMOSPHERE BETWEEN THE GROUND OR HIGHEST CLOUD TOP AND 50 KM ALTITUDE THROUGH THE USE OF THE 15 MICRON ABSORPTION BAND OF CO2.

31. PRINCIPLES OF OPERATION

EACH OF 6 CHANNELS IS CHOSEN TO SAMPLE THE TEMPERATURE AT A DIFFERENT HEIGHT IN THE ATMOSPHERE. (HIGH WAVE NUMBERS SAMPLE LOWER ALTITUDES.) FROM THIS DATA, USING MATHEMATICAL INVERSION TECHNIQUES, THE VERTICAL TEMPERATURE PROFILE AT 10 KM INTERVALS CAN BE INFERRED. INTERFERENCE FILTERS DETERMINE THE SPECTRUM IN EACH CHANNEL. 3 CHANNELS WITH CENTER WAVE NUMBERS AT 675, 967, AND 712 INV.CM USE FILTERS WITH A HALF BANDWIDTH OF 10 INV. CM (0.22 MIC) THE OTHER 3 CHANNELS ARE CENTERED NEAR 668 INV.CM AND HAVE BANDWIDTHS OF 4 INV.CM (0.087 MIC). TO INCREASE THE SELECTIVITY EVEN MORE THE RADIATION IN EACH CHANNEL IS PASSED THROUGH A CELL CONTAINING CO2. FOR THE 3 WIDE BAND AND ONE NARROW BAND CHANNELS THE PASS CAUSES THE ABSORPTION OF THE CENTRAL PORTION OF THE CO2 LINES THUS REDUCING THE 712 INV.CM CHANNEL WIDTH TO 6.6 INV.CM, THE 697 CHANNEL WIDTH TO 2.2 INV.CM, THE 675 CHANNEL WIDTH TO 4 INV. CM AND A 668 CHANNEL WIDTH TO 1.6 INV.CM. THE OTHER 2 CHANNELS ARE EACH SWITCHED BETWEEN 2 CO2 CELLS. ONLY RADIATION FROM THE WINGS OF CO2 ABSORPTION LINES IS CHOPPED; THUS THE BANDWIDTH IS NARROWED TO 1.0 INV.CM FOR ONE CHANNEL AND 0.83 INV.CM FOR THE OTHER. THE DETECTORS ARE THERMISTOR BOLOMETERS SAMPLED ONCE EACH SECOND.

32. PHENOMENA OBSERVED

IR RADIATION EMITTED FROM THE EARTH'S ATMOSPHERE

33. MEASUREMENT RANGE

200 DEGREES K TO 280 DEGREES K

34. PRECISION AND ACCURACY

0.5 DEG K BELOW 3 NM AND 2 DEG C BETWEEN 10 NM AND 20 NM

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
14.5 TO 15.0 MICRON	5.6 PERCENT	1. MILLSEC

38. FIELD OF VIEW	39. GROUND SWATH
10. DEG	35 NM DIAM CIRCLE FROM 200 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
10. DEG	35 NM FROM 200 NM ALTITUDE; VERTICAL=5 NM

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		LOW CIRCULAR	MEDIUM POSIGRADE

46. SPECIAL REQUIREMENTS

IR DATA REQUIRED FOR CALCULATIONS OF VERTICAL TEMP PROFILES

47. COMPONENTS

3 RADIOMETERS, MIRROR, DETECTOR, ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
34 LB	0.5 CU FT	5 WATTS	1 WATT		

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
			SENSITIVE	

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
ONCE/ORBIT, ZERO AND BB	DELAYED TELEMETRY	CONTINUOUS

62. TELEMETRY REQUIREMENTS

6 ANALOG CHANNELS ARE REQUIRED (8 BITS/WORD, SAMPLED ONCE EACH SECOND).

63. ADVANTAGES AND LIMITATIONS

BETTER SPECTRAL RESOLUTION THAN CONVENTIONAL SPECTROMETERS OR INTERFEROMETERS. LIMITED TO ABOVE CLOUDS.

64. REFERENCES

1) SMITH, E.W.: SCR SUBSYSTEM DIRECTORY G.E., PHIL. PA. FEB 68. ***2) MINZNER, R.A.: INTERIM REPORT ON SATELLITE MET INSTRUMENTS NASA/ERC PM-6713, JUNE 1967.***3) GOLDBERG, I.L.: MET IR INSTRUMENTS FOR SATELLITES. PRESENTED AT 13TH ANN TECH SYMP OF SPIE, AUG 1968.***4) APPLICATIONS A AND B PHASE B INTEGRATION STUDY DOCUMENT. NASA/MSC, APRIL 1967.

65. HISTORICAL REMARKS

SIMILAR INSTRUMENT ON NIMBUS D, ALSO PROPOSED FOR NIMBUS F

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
SHORT-WAVELENGTH SPECTROMETER	SWS	S103
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
LOWE, D.S.	UNIVERSITY OF MICHIGAN	313-483-0500-X218
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
NA	NA	NA	NA	INACT	PROPOSAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
TERWILLIGER, R.G.	NASA HDQTRS	OSSA/SRB	202-962-0574

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
		NA	18 MONTHS

26. INSTRUMENT TYPE — 27. SECUR CLASS: PRO

SPECTROMETER, SHORT-WAVELENGTH VISIBLE/NEAR-IR

28. APPLICATION	29. SPACECRAFT
ERSP	APOLLO APPLICATIONS

30. PURPOSE

PRIMARY-TO DETERMINE IF SPECTRA OF TERRAIN FEATURES OBTAINED FROM SPACE THROUGH MAJOR ATMOSPHERIC WINDOWS CAN BE CORRELATED WITH GROUND FIELD SPECTRA.***SECONDARY-TO MEASURE THE SCATTERING AND ABSORPTION EFFECTS OF THE INTERVENING ATMOSPHERE.

31. PRINCIPLES OF OPERATION

THE INSTRUMENT CONSISTS OF 2 ACCURATELY BORESIGHTED REFLECTING TELESCOPES EACH HAVING AN APERTURE OF 4 IN AND A FOV OF 3 MILLI-RADIANS. THIS CORRESPONDS TO A GROUND PROJECTION OF 0.5 NM. HOWEVER, SINCE THE SPACECRAFT WILL TRAVEL 0.42 MI DURING EACH 0.1 SEC SPECTRAL SCAN, THE THEORETICAL MINIMUM TARGET SIZE (UNIFORM, HOMOGENEOUS AREA) IS A 1 NM BY .5 NM RECTANGLE. THE SPECTROMETER WILL COLLECT SPECTRA INTERMITTENTLY OVER A WIDE VARIETY OF TERRAIN FEATURES. EACH SPECTRA WILL CONSIST OF 100 SAMPLINGS, AT A SCAN RATE OF 10 SPECTRA PER SEC. SPECTRA WILL BE RESOLVED BY CIRCULAR VARIABLE FILTERS (CVF) HAVING RESOLVING POWERS OF ABOUT 30. (THE CVF WILL DIVIDE EACH SPECIFIC SPECTRAL REGION INTO 30 PARTS.) THE SHORT WAVELENGTH CVF WILL BE A COMPOUND DEVICE WHEREIN EACH HALF COVERS THE .4-0.75 MICRON AND 0.7-1.35 MICRON REGIONS RESPECTIVELY. THREE DETECTORS WILL BE USED, A PHOTO-MULTIPLIER OR SILICON DETECTOR FOR THE 0.4-0.75 MICRON BAND, AND A GERMANIUM DETECTOR FOR 0.7-1.35 MICRON BAND. A MIRROR CHOPPER WILL BE USED TO TIME SHARE THE BEAM BETWEEN THESE 2 DETECTORS IN SYNCHRONISM WITH THE COMPOUND CVF. A THIRD PBS DETECTOR (PROBABLY COOLED WITH SOLID CO2) WILL BE USED FOR THE 1.3 TO 2.5 MICRON REGION.

32. PHENOMENA OBSERVED

REFLECTANCE OF VISIBLE AND NEAR-IR RADIATION FROM TERRAIN

33. MEASUREMENT RANGE

EXPECTED VALUES OF .00003 TO .03 WATT/SQ-CM/STERADIAN/MICRON

34. PRECISION AND ACCURACY

35. SPECTRAL RANGE — 36. SPECTRAL RESOLUTION — TIME CONSTANT

0.4 TO 2.5 MICRONS

37. FIELD OF VIEW — 38. GROUND SWATH

0.17 DEG 0.4 NM BY 0.9 NM FROM 140 NM ALTITUDE

39. ANGULAR RESOLUTION — SPECTRAL RESOLUTION

0.37 DEG 0.8 NM FROM 140 NM ALTITUDE (SCAN LIMITED)

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
2.0 DEG	0.40 DEG/SEC	LOW CIRCULAR	MEDIUM POSIGRADE

46. SPECIAL REQUIREMENTS

INSTRUMENT MUST BE BORESIGHTED WITH IMAGERS FOR CORRELATION

47. COMMENTS

SPECTROMETER, COOLANT, RECORDER

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
50 LB	2.0 CU FT	48 WATTS	20 WATTS	65 WATTS	

54. ATTITUDE REFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR RADIATION	57. THERMAL INTERFERENCE	58. SHIELDING
				SENSITIVE

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
BY STANDARDIZED LAMPS	DELAYED TELEMETRY	AS PROGRAMMED

62. TELEMETRY REQUIREMENTS

5 HOUSEKEEPING CHANNELS SAMPLED EVERY SECOND FOR A TOTAL OF 40 BITS PER SECOND. TWO DATA CHANNELS EACH PROVIDING 3400 BITS PER SECOND (ANALOG).

63. ADVANTAGES AND LIMITATIONS

64. REFERENCES

1) NASA-EXPERIMENT IMPLEMENTATION PLAN FOR MANNED SPACE FLIGHT EXPERIMENTS-SHORT WAVELENGTH SPECTROMETER (S103), OCT 30, 1967.

65. HISTORICAL REMARKS

DUE TO DELAY IN AAP APPROVAL, INSTR DEVELOPMENT WAS NOT FUNDED

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
STELLAR REFRACTION DENSITY MEASUREMENT	SRDM	S047
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
FISCHBACH, DR. F.F.	UNIVERSITY OF MICHIGAN	313-764-6565
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
NA	NA	NA	NA	INACT	PROPOSAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
TERHILLIGER, R.G.	NASA HDQTRS	OSSA/SRB	202-962-0574

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
NA	NA	NA	

26. INSTRUMENT TYPE — 27. SECURITY: UNC

STAR-TRACKER, 150-INCH F/15 SCHMIDT-CASSEGRAIN TELESCOPE

28. APPLICATION	29. SPACECRAFT
MET	APOLLO APPLICATIONS

30. PURPOSE

PRIMARY-TO TEST A TECHNIQUE FOR OBTAINING DETAILED, GLOBAL, ATMOSPHERIC DENSITY PROFILES (AND THUS TEMPERATURE AND PRESSURE PROFILES) BY MEASURING THE REFRACTION ANGLE OF LIGHT FROM STARS WHICH ARE BEING OCCULTED BY THE EARTH. RESULTING PROFILES WILL BE COMPARED WITH THOSE FROM RADIOSONDES.***SECONDARY-TO OBTAIN INFORMATION ON BACKGROUND RADIANCE NEAR THE HORIZON.

31. PRINCIPLES OF OPERATION

THIS EXPERIMENT USES AN AUTOMATIC, GIMBALLED, STAR-TRACKING DATA TELESCOPE WITH 150-INCH FOCAL LENGTH, F/15 SCHMIDT CASSEGRAIN OPTICS AND AN ITT F4012 VIDISSECTOR PHOTOTUBE. THE INSTANTANEOUS FOV IS 30 SEC MOVABLE OVER A 5 MIN FIELD. AN ACQUISITION TELESCOPE, USED TO ACQUIRE THE STAR AND AIM THE DATA TELESCOPE, HAS AN INSTANTANEOUS FOV OF 8 MIN AND IS MOVABLE OVER A 2 DEG FIELD. IN OPERATION AN ASTRONAUT SELECTS AN OCCULTING STAR A FEW DEG ABOVE THE HORIZON: HE MANEUVERS THE S/C SO THAT THE STAR IS IN THE ACQUISITION TRACKER'S FOV. WHEN THE STAR IS TRACKED TO WITHIN AN ARC-MIN OF THE CENTER, CONTROL IS SHIFTED TO THE DATA TELESCOPE WHICH TRACKS TO ITS CENTER WITHIN A FEW ARC-SEC. GYROS MOUNTED ON THE TELESCOPE TUBE ARE UNCAGED AND MEASURE THE TUBE'S MOTION AS THE STAR IS TRACKED. REFRACTION ANGLES INCREASE FROM 0 TO 40 ARC-MIN DURING OCCULTATION WHICH TAKES ABOUT 40 SEC OF TIME. SINCE THE TELESCOPE IS TOO MASSIVE TO FOLLOW EVERY EXCURSION WITH ARC-SEC PRECISION, AN ELECTRONIC OFF-AXIS SIGNAL IS RECORDED AND ADDED TO THE GYRO OUTPUT. THE SUM EQUALS THE INSTANTANEOUS ANGLE OF REFRACTION. AN INVERSION TECHNIQUE GIVES THE INDEX OF REFRACTION AT THE RAY'S TANGENT POINT TO THE EARTH FROM WHICH A DENSITY PROFILE IS DEDUCED.

32. PHENOMENA OBSERVED

STELLAR REFRACTION ALONG TWO AXES (ELEVATION AND AZIMUTH)

33. MEASUREMENT RANGE

ACQUIRE STARS OF MAGNITUDE 1 TO 5; TRACK THRU RANGE OF 1 TO 8 M

34. PRECISION AND ACCURACY

STAR TRACKER ACCURACY IS 2 SEC OF ARC RMS

35. SPECTRAL RANGE — 36. SPECTRAL RESOLUTION — TIME CONSTANT

0.45 TO .7 MICRON NA NA

38. FIELD OF VIEW — 39. GROUND SWATH

SEE ITEM 31 NA

40. ANGULAR RESOLUTION — SPATIAL RESOLUTION

NA NA

42. POINTING ACCURACY — 43. POINTING RATE — 44. ALTITUDE — ORBIT INCLINATION

0.5 DEG 0.05 DEG/SEC LOW CIRCULAR MEDIUM POSTGRADE

46. SPECIAL REQUIREMENTS

GYRO DRIFT L 0.05 DEG/HR; OPERATES DURING NIGHT PHASE ONLY

47. COMPONENTS

2 STAR-TRACKING TELESCOPES, 2 GYROSCOPES, MONITORING PANEL

48. WEIGHT — 49. VOLUME — 50. AVERAGE POWER — 51. STANDBY POWER — 52. PEAK POWER — 53. MTBF

110 LB 6.0 CU FT 65 WATTS 104 WATTS

54. RF INTERFERENCE — 55. MAGNETIC INTERFERENCE — 56. NUCLEAR INTERFERENCE — 57. THERMAL INTERFERENCE — 58. ENVIRONMENTAL

REQUIRED AGAINST VIS RAD

59. CALIBRATION — 60. DATA RECOVERY — 61. MODE OF OBSERVATION

NONE DELAYED TELEMETRY 4 STAR TRACKS/ORB

62. TELEMETRY REQUIREMENTS

1 KILOBIT PER SECOND DURING EACH 40 SECOND OCCULTATION. FOUR OR FIVE OCCULTATIONS DURING EACH ORBIT THE EXPERIMENT IS CONDUCTED.

63. ADVANTAGES AND LIMITATIONS

S/C MUST MANEUVER TO ACQUIRE EACH STAR, SIMULTANEOUS RADIOSONDE DATA IS REQUIRED, INSTRUMENT REQUIRES 30 MINUTE WARM-UP PERIOD.

64. REFERENCES

1) APPLICATIONS A AND B PHASE B INTEGRATION STUDY DOCUMENT. NASA/MSC, APRIL 1967.***2) FISCHBACH, F.F.: MEASUREMENT OF ATMOSPHERIC STRUCTURE BY REFRACTION STAR TRACKING TECHNIQUE, (PROPOSAL). JUNE 1966, U. OF MICHIGAN.

65. MISCELLANEOUS REMARKS

DUE TO DELAY IN AAP APPROVAL, INSTR DEVELOPMENT WAS NOT FUNDED

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
UHF-SFERICS DETECTION EXPERIMENT	UHFSD	S048
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0003

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
ROSSBY, DR, S.A.	NATL CTR FOR ATMOS RES	303-444-5151
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
NELSON, D.F.	AEROSPACE CORP.	213-648-7244

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. REACH INDEX NUMBER	15. START DATE	16. TERMINATION DATE	17. STATUS
NA	NA	NA	NA		INACT PROPOSAL

18. MONITOR	19. AGENCY	20. GSA OFFICE	21. TELEPHONE
TERWILLIGER, R.G.	NASA HDQTRS	OSSA/SRB	202-962-0574

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
		NA	

26. INSTRUMENT TYPE	27.
RECEIVER, UHF LOW-NOISE	UNC

28. APPLICATION	29. SPACECRAFT
MET	APOLLO APPLICATIONS

30. PURPOSE

PRIMARY - TO MEASURE THE FIELD STRENGTH OF UHF SFERICS.***SECONDARY-TO DETERMINE THE GLOBAL DISTRIBUTION OF THUNDERSTORM ACTIVITY WITHIN THE ORBITAL LIMITATIONS OF THE SPACECRAFT.***TERTIARY - TO DISTINGUISH, IF POSSIBLE, BETWEEN LIGHTNING AND NON-LIGHTNING ASSOCIATED SFERICS. NON-LIGHTNING ASSOCIATED SFERICS MAY BE USED TO INDICATE THE DEVELOPMENT OF INTENSE CONVECTION.

31. PRINCIPLES OF OPERATION

THE INSTRUMENT IS A LOW NOISE UHF RECEIVER TUNED TO 610 MHZ WITH A 2 MHZ BANDWIDTH. THE SFERICS PULSES (WHICH ARE DETECTED) APPEAR AT THE VIDEO OUTPUT OF A LOGARITHMIC IF AMPLIFIER AND ARE MEASURED BY PULSE-HEIGHT AND WIDTH-DISCRIMINATING ELECTRONICS. THE FRONT END OF THE RECEIVER IS A PARAMETRIC AMPLIFIER FED BY A CAVITY-BACKED PLANAR ARCHIMEDEAN-SPIRAL ANTENNA. THE SYSTEM NOISE FIGURE WILL BE LESS THAN 3 DB. THE AMPLITUDE OF THE LARGEST SFERIC IN EACH 100 MILLISEC SAMPLING INTERVAL WILL BE DIGITIZED TO 6 BITS. PULSE-WIDTH DISCRIMINATING ELECTRONICS DETERMINE WHETHER THE PEAK SFERIC WAS A SINGLE SHORT PULSE (1-2 MICROSEC) OR WHETHER IT WAS ASSOCIATED WITH A BURST OF PULSES TAKING SEVERAL TENS OF MICROSEC. THE LATTER IS CHARACTERISTICALLY ASSOCIATED WITH LIGHTNING BUT NOT THE FORMER. THE ANTENNA BEAM PROPOSED IS A RIGHT CIRCULAR CONE WITH A HALF-POWER BEAMWIDTH OF 50 DEG. A SCHEME THAT ALLOWS SWITCHING OF BEAMWIDTHS HAS BEEN DEVELOPED AND WILL BE INCORPORATED IF COMPATIBLE WITH THE SPACECRAFT. THIS WOULD PROVIDE A NARROW BEAM, 20-25 DEG, IN ONE MODE (ASTRONAUT PARTICIPATION) AND A BROAD BEAM, 70-80 DEG, (UNMANNED OPERATION) IN THE OTHER MODE.

32. PHENOMENA OBSERVED

UHF SFERICS RADIATED FROM THE EARTH AND ITS ENVIRONS

33. MEASUREMENT RANGE

RECEIVER HAS A MAXIMUM NOISE OF 3 DB; ANTENNA GAIN IS 6 DB

34. PRECISION AND ACCURACY

SIGNAL TO NOISE RATIO OF 17.5 TO 27.5 DB

35. SPECTRAL FREQUENCY	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
610.	MHZ	NA

38. FIELD OF VIEW	39. GROUND SWATH
SEE ITEM 31	NA

40. ANGULAR FIELD OF VIEW SPATIAL RESOLUTION

SEE ITEM 31 NA

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
2.0 DEG		LOW CIRCULAR	MEDIUM POSIGRADE

46. SPECIAL REQUIREMENTS

SIMULTANEOUS REFERENCE PHOTOGRAPHY

47. COMPONENTS

UHF RECEIVER, ANTENNA SYSTEM, SIGNAL-PROCESSING UNIT

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
33 LB	0.9 CU FT	5 WATTS		6 WATTS	

54. INTERFERENCE RF	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
SOURC/SEN				

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION

62. TELEMETRY REQUIREMENTS

1 BUFFERED DIGITIZER OUTPUT CONTAINING 8 AND 10 BIT WORDS PER EVENT AND 50 BITS/SEC FOR NOISE-PULSE DATA. 8-BIT WORDS SAMPLED ONCE EVERY 50 MS, 10-BIT WORDS ONCE EVERY 100 MS. TOTAL= 310 BPS

63. ADVANTAGES AND LIMITATIONS

A HIGHER INCLINATION WOULD PROVIDE MORE CLASSES OF THUNDERSTORMS FOR STUDY; LOWER ALTITUDES WOULD PROVIDE STRONGER SFERICS

64. REFERENCES

1) APPLICATIONS A AND B PHASE B INTEGRATION STUDY DOCUMENT. NASA/MSC, APRIL 1967.***2) ROSSBY, S.A. AND NELSON, D.A.: MEASUREMENT OF SFERICS FIELD STRENGTH FROM A SATELLITE. SEPT. 1966.***3) NASA EXPERIMENT IMPLEMENTATION PLAN FOR UHF SFERICS DETECTION (S048). OCTOBER 30, 1967.

65. HISTORICAL REMARKS

DUE TO DELAY IN AAP APPROVAL, INSTR DEVELOPMENT WAS NOT FUNDED.

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
VISIBLE-RADIATION POLARIZATION EXPERIMENT	VRP	S046
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
SEKERA, DR. Z.	UNIV CALIFORNIA, L.A.	213-825-4134
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
HARTHARAN, DR. T.A.	UNIV CALIFORNIA, L.A.	213-825-4445

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
NA	NA	NA	NA	INACT	PROPOSAL

18. MONITOR	19. AGENCY	20. FOA OFFICE	21. TELEPHONE
TERWILLIGER, R.G.	NASA HDQTRS	OSSA/SRB	202-962-0574

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
NA	NA	NA	

26. INSTRUMENT TYPE	27. ACRONYM
POLARIMETER, 3-CHANNEL ELECTROMECHANICAL PHOTOMULTIPLIER	PRO

28. APPLICATION	29. SPACECRAFT
MET, ATM-PHYS	APOLLO APPLICATIONS

30. PURPOSE

PRIMARY-TO DETERMINE ATMOSPHERIC PARAMETERS SUCH AS AEROSOL CONTENT, CONCENTRATION, DISTIRBUTION, AND TURBIDITY BY ACQUIRING AND ANALYZING DATA ON THE INTENSITY AND POLARIZATION OF LIGHT EMERGING FROM THE EARTH'S ATMOSPHERE IN THE VISIBLE REGION FOR A RANGE OF ANGLES OF VIEW AND VARIOUS SUN ANGLES.

31. PRINCIPLES OF OPERATION

THE POLARIMETER IS DESIGNED TO MEASURE 3 OF THE 4 STOKES PARAMETERS, I,Q, AND U, OF THE EMERGENT RADIATION FLUX FROM THE EARTH'S SURFACE BY COMPARING THE POLARIZED BEAMS WITH UNPOLARIZED BEAMS. COMPARISON IS ACCOMPLISHED BY AN ELECTROMECHANICALLY-DRIVEN BEAM SELECTOR WHEEL WHICH IS PLACED IN THE FOCAL PLANE OF THE 3 COLLIMATING LENSES. MEASUREMENTS WILL BE MADE IN 4 SELECTED SPECTRAL REGIONS, 3800, 4400, 5000, AND 5800 A, USING APPROPRIATE FILTERS. ONE SET OF STOKES PARAMETERS IN EACH OF THE 4 SPECTRAL BANDS WILL BE OBTAINED EACH SECOND. PROVISION WILL BE MADE FOR AN ADEQUATE DYNAMIC RANGE BY BOTH OPTICAL AND ELECTRONIC MEANS. A SINGLE PHOTOMULTIPILER TUBE WILL BE USED AS THE DETECTOR. IN-FLIGHT CALIBRATION WILL BE ACCOMPLISHED BOTH BY VIEWING THE SUN THROUGH A FILTER SEVERAL TIMES DURING THE MISSION AND BY VIEWING A 12 WATT TUNGSTEN-IODINE LAMP PRECEDING AND FOLLOWING EACH TARGET OBSERVATION. THE INSTRUMENT WILL TRACK A TARGET ON THE EARTH'S SURFACE AND A SCAN MECHANISM WILL TAKE INTO ACCOUNT THE EFFECTS OF ORBITAL INCLINATION, PRECISION ADJUSTMENTS, ECCENTRICITY, PERIOD, THE EARTH'S OBLATENESS, TARGET LATITUDE, AND HEIGHT. A MINUMUM OF 100 SCANS AT 6 MINUTES PER SCAN WILL BE MADE.

32. PHENOMENA OBSERVED

INTENSITY AND POLARIZATION OF VISIBLE LIGHT FROM THE ATMOSPHERE

33. MEASUREMENT RANGE

DYNAMIC RANGE = 0.00082 TO 0.013 WATTS/SQ-CM/STERADIAN/MICRON

34. PRECISION AND ACCURACY

POLARIZATION TO WITHIN 3 PERCENT

35. SPECTRAL RANGE			36. SPECTRAL RESOLUTION	37. TIME CONSTANT
3800.	TO	5800. A	7.5 PERCENT	1.0 SEC

38. FIELD OF VIEW	39. GROUND SWATH
3. DEG	10.5 NM DIAM CIRCLE FROM 200 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
3. DEG	10.5 NM FROM 200 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
0.5 DEG	0.2 DEG/SEC	LOW CIRCULAR	MEDIUM POSIGRADE

46. SPECIAL REQUIREMENTS

CAMERA REQUIRED TO CORRELATE EXPERIMENT

47. COMPONENTS

POLARIMETER, SCANNING MECHANISM, CALIBRATORS, ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
45 LB	2.0 CU FT	20 WATTS	20 WATTS	50 WATTS	1 YEAR

54. INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
SEE ITEM 31	DELAYED TELEMETRY	AS PROGRAMMED

62. TELEMETRY REQUIREMENTS

187 BITS PER SECOND

63. ADVANTAGES AND LIMITATIONS

AEROSOL CONTENT DATA WILL BE USEFUL IN INTERPRETATION OF IR RADIOMETRIC DATA; MOVING PARTS

64. REFERENCES

1) APPLICATION A AND B PHASE B INTEGRATION STUDY DOCUMENT. NASA/MSC, APRIL 1967.***2) MINZNER, R.A. ED: INTERIM REPORT ON SATELLITE METEOROLOGICAL INSTRUMENTS. NASA/ERC PM-6713, JUNE 1967.***3) SEKERA, Z. AND HARIHARAN, T.: PROPOSAL FOR VISIBLE RADIATION POLARIZATION MEASUREMENTS FROM UNMANNED SPACECRAFT. UCLA, JAN. 1968

65. HISTORICAL REMARKS

THIS INSTRUMENT WAS ALSO PROPOSED FOR NIMBUS E.

66. COMMENTS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO.
WATER-VAPOR-RESONANCE MICROWAVE RADIOMETER	WVRMR	S077
(TITLE CONT.)	4. RESUME DATE	5. LAST CH
	11/10/69	0003

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
STAELIN, DR. D.H.	MASS INSTITUTE OF TECH	617-864-6900X3711
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
BARATH, F.T.	JET PROPULSION LAB	213-354-3025

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
NA	NA	NA	NA		INACT PROPOSAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
TERRILLIGER, R.G.	NASA HDQTRS	OSSA/SRB	202-962-0574

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TYPE
		NA	

26. INSTRUMENT TYPE

RADIOMETER, 5-CHANNEL MECHANICALLY-SCANNING DICKE MICROWAVE UNC

28. APPLICATION	29. SPACECRAFT
MET, ERSP	APOLLO APPLICATIONS

30. PURPOSE

PRIMARY-TO MEASURE AND MAP THE THERMAL MICROWAVE EMISSION FROM THE TERRESTRIAL SURFACE AND ATMOSPHERE NEAR THE 1.35 CM WATER VAPOR RESONANCE, AND THEREBY OBTAIN INFORMATION CONCERNING THE VARIATION OF THE ATMOSPHERIC WATER VAPOR ABUNDANCE AND DISTRIBUTION WITH ALTITUDE, LIQUID WATER CONTENT OF THE ATMOSPHERE, SURFACE BRIGHTNESS TEMPERATURES, AND SEA STATE.

31. PRINCIPLES OF OPERATION

THE WATER-VAPOR RESONANCE MICROWAVE RADIOMETER CONSISTS OF A MECHANICALLY-SCANNING 5-CHANNEL DICKE MICROWAVE RADIOMETER AND ANTENNAS (2 OF THE CHANNELS SHARE AN ANTENNA). THE CHANNEL FREQUENCIES ARE 10, 19, 22.2, 32 AND 52.8 GHZ. THE ANTENNAS 14 CM. WITH BEAMWIDTHS OF APPROXIMATELY 5 DEG, THE ANTENNAS SCAN THE EARTH'S SURFACE NORMAL TO THE S/C GROUND TRACK OUT TO 60 DEG ON EACH SIDE. IN THE GROUND TRACK-SPACECRAFT PLANE THE ANTENNAS POINT EITHER 50 DEG AHEAD OR BEHIND THE NADIR. A SCAN PERIOD (120 DEG AND BACK) TAKES 40 SEC WITH AN INTEGRATION TIME OF 1 SEC FOR EACH INSTANTANEOUS FOV. THIS FOV IS 50 BY 100 KM; HOWEVER, THE S/C MOTION DURING THE INTEGRATION TIME SMEARS THIS TO 100 BY 100 KM. THE RADIATION INTENSITY IS INFERRED FROM THE MEASURED ANTENNA TEMPERATURES USING ONE MINUTE CALIBRATION SEQUENCES EVERY 10 MIN AND BY ROLLING THE S/C TO LOOK AT COLD SPACE FOR A MINIMUM OF 10 MIN EVERY 6 HR. THE DESIRED ATMOSPHERIC AND SURFACE PARAMETERS ARE OBTAINED FROM THE 5 INTENSITY MEASUREMENTS BY STATISTICAL PARAMETER-ESTIMATION TECHNIQUES.

32. PHENOMENA OBSERVED

MICROWAVE RADIATION EMITTED FROM THE EARTH'S SURFACE/ATMOSPHERE

33. MEASUREMENT RANGE

BRIGHTNESS TEMPERATURE FROM ZERO TO 400 DEGREES KELVIN

34. PRECISION AND ACCURACY

SENSITIVITY IS ABOUT 0.3 TO 1.5 DEG K FOR 1 SEC INTEGRATION TIME

0.57 TO 3.0 CM 0.33 PERCENT

120. BY 5.0 DEG 700 NM BY 50 NM FROM 200 NM ALTITUDE

14.0 DEG 50 NM (WITH SMEAR) FROM 200 NM ALTITUDE

2.0 DEG 0.5 DEG/SEC LOW CIRCULAR MEDIUM POSIGRADE

5 DICKE-TYPE RADIOMETERS, 4 ANTENNAS, ELECTRONICS

80 LB 13.0 CU FT 180 WATTS 244 WATTS

SEE ITEM 31 DELAYED TELEMETRY CONTINUOUS

5 SCIENCE OUTPUTS, EACH SAMPLED TWICE PER SECOND WITH 10 BIT ACCURACY; 10 ENGINEERING OUTPUTS, EACH SAMPLED ONCE EVERY 10 SECONDS WITH 8 BIT ACCURACY. TOTAL IS 108 BITS/SEC.

LIGHT-TO-MED CLOUDS WILL NOT AFFECT THE RESULTS AS MUCH AS THEY WOULD FOR IR SOUNDINGS; VERY HEAVY CLOUDS AND RAIN WILL DEGRADE

64. REFERENCES

1) NASA APPLICATIONS A AND B PHASE INTEGRATION STUDY DOCUMENT. NASA/MSC, APRIL 1967.***2) MINZNER, R.A.ED.: INTERIM REPORT ON SATELLITE METEOROLOGICAL INSTRUMENTS. NASA/ERC PM-6713, JUNE 1967.

65. HISTORICAL REMARKS

ORIGINALLY S044A, PART OF INTEGRATED PASSIVE MICROWAVE EXPT.

66. DIAGRAMS

NIMBUS D

(PROPOSALS ONLY)

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
CLOUD-TOP ALTITUDE RADIOMETER	CAR	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0006

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
WARK, DR. D.Q.	NAT ENV SAT CTR ESSA	301-440-7114
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
SAIEDY, DR. F.	UNIVERSITY OF MARYLAND	301-735-0021

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
NA	NA	NA	NA	INACT	PROPOSAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B. B.	NASA HDQTRS	OSSA/SRN	202-962-0891

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
NA	NA	NA	NA

26. INSTRUMENT TYPE (21 MEASURED)

SPECTROMETER, SINGLE GRATING LITTROW TYPE — UNC

28. APPLICATION	29. SPACECRAFT
MET	NIMBUS D

30. PURPOSE

PRIMARY-TO DETERMINE CLOUD TOP ALTITUDE TO AN ACCURACY OF A FEW HUNDRED METERS.***SECONDARY-TO ESTIMATE THE THICKNESS OF CLOUDS AND THEIR LIQUID WATER CONTENT.

31. PRINCIPLES OF OPERATION

THE INSTRUMENT PROPOSED FOR THIS EXPERIMENT IS A SINGLE GRATING LITTROW SPECTROMETER WHICH MEASURES, SIMULTANEOUSLY, RADIANCES IN 3 NARROW, SPECTRAL REGIONS: 2 REGIONS ARE IN THE OXYGEN "A" BAND AT 0.76 MICRON, AND ONE IS JUST OUTSIDE THE BAND. THIS REGION, CENTERED AT 7578 A, SERVES AS A REFERENCE SIGNAL. THE 2 REGIONS IN THE BAND, ONE CENTERED AT 7606 A, THE OTHER CENTERED AT 7631 A GIVE CLOUD-TOP HEIGHT INFORMATION FOR HIGH ALTITUDE CLOUDS AND LOW TO MEDIUM ALTITUDE CLOUDS RESPECTIVELY. BY RECORDING SOLAR AND VIEWING ANGLE MEASURING THE ATTENUATION DUE TO MOLECULAR OXYGEN IN THE AIR FOR THE LIGHT REFLECTED FROM THE CLOUD TOP, THEN KNOWING THE DEPENDENCE OF THIS ATTENUATION ON PATH LENGTH AND ANGLE OF VIEW THE CLOUD-TOP HEIGHT IS DEDUCED. THE CENTER OF EACH WAVELENGTH REGION IS SET TO WITHIN 1 A OF THE NOMINAL VALUE, AND THE BANDPASS OF EACH REGION AT HALF-MAXIMUM TRANSMISSION IS 8.0 A TO WITHIN 0.5 A. THE INSTRUMENT SCANS SPATIALLY ACROSS THE SUBSATELLITE TRACK OUT 22.5 DEG ON EACH SIDE OF THE NADIR IN 80 DISCRETE STEPS. THE RADIANCE IN EACH OF THE THREE WAVELENGTH REGIONS IS DIGITIZED AS A 10 BIT NUMBER STORED IN THE S/C RECORDER. CALIBRATION IS PERFORMED WHEN NEEDED BY VIEWING THE SUN USING A DIFFUSE REFLECTOR.

32. PHENOMENA OBSERVED

RELATIVE INTENSITY OF REFLECTED SOLAR RADIATION FROM CLOUDS

33. MEASUREMENT RANGE

INTENSITY RANGES 2.4 TO 240 ERG/SEC/SQ-CM/STERADIAN/MICRON

34. PRECISION AND ACCURACY

CLOUD HEIGHT WITHIN 200 M; ABSOLUTE ALBEDO:3% AT FULL SCALE

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
7578.0 TO 7631.0 A	0.1 PERCENT	1.0 MILLSEC

38. FIELD OF VIEW	39. GROUND SWATH
45.0 DEG	250 NM DIAM CIRCLE FROM 600 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.5 DEG	6.3 NM AT THE CENTER FROM 600 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
0.5 DEG		MED CIRCULAR	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

SPECTROMETER, ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
23 LB	7.4 CU FT	7 WATTS		13 WATTS	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
				SENSITIVE

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
SEE ITEM 31	DELAYED TELEMETRY	DAYLIGHT ONLY

62. TELEMETRY REQUIREMENTS

3 PRIMARY CHANNELS SAMPLED WITH 10 BIT RESOLUTION 80 TIMES IN 1 SEC FOR A PEAK BIT RATE OF 2.4 K BITS/SEC. THE 0.6 SEC RETRACE RESULTS IN REDUCTION OF EFFECTIVE BIT RATE TO 1.8 K BITS/SEC.

63. ADVANTAGES AND LIMITATIONS

INVERSION TECHNIQUES NOT NEEDED; CORRECTION FOR ABSORPTION IN CLOUD NEEDED. COVERAGE GAP FOR ADJACENT ORBITS 1000NM AT EQUATOR

64. REFERENCES

1) SAIEDY, F. ET.AL.: CLOUD TOP ALTITUDE MEASUREMENT FROM SATELLITES. APPLIED OPTICS, VOL. 4 1965.***2) MINZNER,R.A.:INTERIM REPT ON SATELLITE MET INSTRUMENTS.NASA/ERC PM-6713,JUN 1967.***3) WARK, D.Q. AND MERCER, D.M.:ABSORPTION IN THE ATMOSPHERE BY THE OXYGEN-A-BAND. APPLIED OPTICS, VOL 4, 1965.***4) PROPOSAL FOR A CLOUD-TOP ALTITUDE RADIOMETER FOR NIMBUS D.ESSA, JAN 1966.

65. HISTORICAL REMARKS

THIS INSTRUMENT DID NOT RECEIVE FINAL APPROVAL FOR FLIGHT.

66. DIAGRAM

NIMBUS E

(PROPOSALS ONLY)

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
AERONOMY EXPERIMENT	AERON	E09
(TITLE CONT.)	4. RESUME DATE	5. [illegible]
	11/10/69	0006

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
LAWSON, J.	MASSACHUSETTS INST TECH	619-864-6900
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
NEWELL, DR. R.	MASSACHUSETTS INST TECH	619-864-6900-X2940

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
NA	NA	NA	NA	INACT	PROPOSAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B. B.	NASA HDQTRS	OSSA/SRN	202-962-0891

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
		NA	

26. INSTRUMENT TYPE — 27. [illegible]
SPECTROMETER, LIMB-SCANNING PHOTOMETRIC — PRO

28. APPLICATION	29. SPACECRAFT
MET, ATM-PHYS	NIMBUS E

30. PURPOSE

PRIMARY-TO MEASURE THE VERTICAL DISTRIBUTION OF DENSITY, TEMPERATURE, AND CERTAIN TRACE CONSTITUENTS, ON A GLOBAL SCALE *** SECONDARY-TO TEST A TANGENTIAL-VIEWING SATELLITE EXPERIMENT FOR DETERMINING ATMOSPHERIC PROCESSES ABOVE 25 KILOMETERS.

31. PRINCIPLES OF OPERATION

THE ATMOSPHERE IS TO BE SCANNED ACROSS THE LIMB OF THE EARTH WITH A PHOTOMETER HAVING A NARROW FIELD OF VIEW.THE SYSTEM CONSISTS OF A REFLECTIVE LENS TO COLLECT ENERGY AND FOCUS IT ON A SLIT APERTURE,A SET OF IMAGE DISSECTING MIRRORS,AND BEHIND EACH MIRROR,A FILTER AND SENSOR FOR THE ASSOCIATED WAVELENGTH.THE FILTER MIRRORS ARE SELECTED AND PLACED SUCH THAT EACH PASSES A DIFFERENT NARROW WAVELENGTH BAND TO A PHOTODIODE OR OTHER DETECTOR AND REFLECTS THE REMAINING WAVELENGTHS ONTO THE NEXT FILTER MIRROR.THE WAVELENGTHS TO BE MEASURED ARE 2600-4000 A,5770 A,AND 6 AND 15 MICRONS.USING SATELLITE ATTITUDE INFORMATION,HORIZON AND SUN SENSORS WILL BE USED TO DETERMINE THE ATTITUDE OF THE PHOTOMETER RELATIVE TO THE HORIZON.SCANNING IN ALTITUDE IS ACCOMPLISHED BY PITCHING THE OPTICAL SYSTEM. A STAR OCCULTOMETER WILL ALSO BE USED TO PROVIDE INFORMATION ON ABSORBING AND SCATTERING ATMOSPHERIC COMPONENTS, SUCH AS AIR AND OZONE, DURING THE NIGHTSIDES OF THE ORBITS.THE SYSTEM TRACKS A STAR LOCATED NEAR THE ORBITAL PLANE AND MEASURES ITS INTENSITY AS IT MOVES INTO OR OUT OF THE ATMOSPHERE DUE TO VEHICLE ORBITAL MOTION. PHOTOMETRIC INSTRUMENTS PRODUCE A SIGNAL WHICH IS PROPORTIONAL TO THE INCIDENT RADIATION INTENSITY.

32. PHENOMENA OBSERVED

SOLAR AND STELLAR UV ENERGY PASSING THROUGH THE ATMOSPHERE

33. MEASUREMENT RANGE

INTENSITIES OF 0.1 PICOWATTS TO 0.1 MILLIWATTS

34. PRECISION AND ACCURACY

MAXIMUM NOISE ESTIMATED TO BE 2 PERCENT OF MAXIMUM INTENSITY

35. [illegible]	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.26 TO 15.0	MICRONS	0.1 SECOND

38. FIELD OF VIEW	39. GROUND SWATH
0.04 BY 4.6 DEG	1 KM BY 111 KM FROM 250 KM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.04 DEG	1 KM FROM 250 KM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
0.02 DEG		LOW	HIGH

46. SPECIAL REQUIREMENTS

WILL REQUIRE ON-BOARD COMPUTER TO PROGRAM EXPERIMENT

47. COMPONENTS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
PRIOR TO MEASUREMENT	DELAYED TELEMETRY	WHENEVER POSSIBLE

62. TELEMETRY REQUIREMENTS

63. ADVANTAGES AND LIMITATIONS

VERY ACCURATE ATTITUDE CONTROL REQUIRED, PITCHES ENTIRE S/C FOR VERTICAL SCAN MODE, REQUIRES ON-BOARD COMPUTER.

64. REFERENCES

1) LAWSON, J. AND NEWELL, R.: PROPOSAL FOR A MIT AERONOMY EXPERIMENT, E-2220, FEB 68.***2) LAWSON, J.: DATA ACQUISITION AND REDUCTION MIT X-15 HORIZON DEFINITION EXPERIMENT PHASE 2, MIT INSTRUMENTATION LAB, DEC 66.

65. HISTORICAL REMARKS

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
AIR POLLUTION SURVEY EXPERIMENT	APSURV	E21
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
GORSCHBOTH, DR. F.F.	IBM FEDERAL SYSTEMS DIV.	301-657-2900
9. CO INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
BARRINGER, DR. A.R.	BARRINGER RESEARCH LTD	416-677-2491

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
NA	NA	NA	NA	INACT	PROPOSAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B. B.	NASA HDQTRS	OSSA/SRN	202-962-0891

22. VENDOR	23. LOCATION	24. FREIGHT DATE	25. LEAD TIME
BARRINGER RESEARCH	REXDALE, TORONTO, CANADA	NA	

26. INSTRUMENT TYPE	27. INCLUDES
SPECTROMETER, ULTRAVIOLET CROSS-CORRELATING GRATING OR PRISM	PRO

28. APPLICATION	29. SPACECRAFT
MET, ERSP	NIMBUS E

30. PURPOSE

PRIMARY-TO DEVELOP THE CAPABILITY OF OBTAINING GLOBAL ATMOSPHERIC POLLUTION DATA.***SECONDARY-TO DETERMINE THE DEGREE TO WHICH NATURAL UV RADIATION REFLECTED FROM EARTH CAN BE DETECTED AT SATELLITE ALTITUDES.TO IDENTIFY SULFUR DIOXIDE AND NITROUS DIOXIDE VAPOROUS POLLUTANTS AND TO DETERMINE MASS TRANSPORT MECHANISMS OF POLLUTANTS.

31. PRINCIPLES OF OPERATION

THE AIR POLLUTION SURVEY SYSTEM WILL BE USED TO INVESTIGATE THE CONCENTRATION AND DISTRIBUTION OF SELECTED VAPOROUS POLLUTANTS. TWO CORRELATING SPECTROMETERS, EACH INVESTIGATING A SINGLE ATMOSPHERIC POLLUTANT - INDUSTRIAL DISCHARGE(SO2) AND AUTOMOBILE EXHAUST(NO2) - WILL BE USED. THE DESIGN IS BASED ON THE BARRINGER/AISI REMOTE SENSING SULPHUR DIOXIDE MONITOR. THE SPECTROMETER OPTICS HAVE AN INSTANTANEOUS FIELD OF VIEW OF ONE DEGREE WHICH IS SWEPT THROUGH PLUS AND MINUS 15 DEGREES NORMAL TO THE LINE OF FLIGHT. THE ABSORPTION SPECTRUM OF INCOMING RADIATION IS OPTICALLY CROSS-CORRELATED AGAINST A STORED REPLICA OF THE SPECTRUM OF THE THE GAS TO BE DETECTED, AND PROVIDES AN ELECTRICAL OUTPUT DIRECTLY RELATED TO THE INTEGRAL DENSITY OF THE GAS ALONG THE VIEWING PATH. THIS TECHNIQUE OF CORRELATION SPECTROMETRY MEASURES THE INTEGRAL OF POLLUTION DENSITY OVER THE ENTIRE DISTANCE THAT LIGHT TRAVELS FROM THE SUN TO THE GROUND AND BACK TO THE SATELLITE. FOR THIS REASON SATELLITE MEASUREMENTS WOULD BE SUPERIOR TO GROUND MEASUREMENTS FOR DETERMINING TOTAL ATMOSPHERIC POLLUTANT BURDEN OR TOTAL POLLUTANT TRANSPORT ACROSS A BOUNDARY.

32. PHENOMENA OBSERVED

UV RADIATION REFLECTED FROM THE EARTH'S SURFACE

33. MEASUREMENT RANGE

20 TO 2000 PPM/METER FOR BOTH SO2 AND NO2

34. PRECISION AND ACCURACY

+-50 PERCENT AT 20 PPM/METER; +-10 PERCENT AT 2000 PPM/METER

35. SPECTRAL RANGE			36. SPECTRAL RESOLUTION	37. TIME CONSTANT
2800.	TO	5000. A	0.23 PERCENT	

38. FIELD OF VIEW	39. GROUND SWATH
30. BY 1.0 DEG	322 NM BY 10 NM FROM 600 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
1.0 DEG	10 NM FROM 600 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

SPECIAL SUN ANGLE LIMITATIONS MAY BE NECESSARY

47. COMPONENTS

2 CORRELATION SPECTROMETERS, FOREOPTICS, SCANNING MIRROR SYSTEM

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
30 LB	1.0 CU FT	15 WATTS	NONE	18 WATTS	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
NONE	DELAYED TELEMETRY	SPECIFIC AREAS

62. TELEMETRY REQUIREMENTS

7 BITS PER SECOND COMPRISING 11 DATA CHANNELS, 12 HOUSEKEEPING CHANNELS, AND 6 DIGITAL MONITOR CHANNELS.

63. ADVANTAGES AND LIMITATIONS

METHOD OF PRODUCING SPECTRUM MASK PRODUCES A REPLICA WHICH CONTAINS ALL ABERRATIONS OF THE SPECTROMETER; OZONE MAY BE PROBLEM

64. REFERENCES

1) GORSCHBOTH, F. AND BARRINGER, A.: PROPOSAL FOR AN AIR POLLUTION EXPERIMENT, IBM CORP, FEB 68.***2) BARRINGER, A.: AIRBORNE MEASUREMENTS OF ATMOSPHERIC SULPHUR DIOXIDE OVER WASHINGTON, DC, 1967.

65. HISTORICAL REMARKS

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE			2. ACRONYM, 3. EXP NO
ALBEDO EXPERIMENT			ALBEDO E27
(TITLE CONT.)		4. RESUME DATE	5. VERSION
		11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
BROWN, I.	RCA ASTRO-ELECTRONICS	
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
NA	NA	NA	NA	INACT	PROPOSAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B. B.	NASA HDQTRS	OSSA/SRN	202-962-0891

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
RCA ASTRO-ELECTRONICS	PRINCETON, N.J.	NA	

26. INSTRUMENT TYPE	27. SECURITY
RADIOMETER, TWO SILICON SOLAR-CELL	UNC

28. APPLICATION	29. SPACECRAFT
ATM-PHYS	NIMBUS E

30. PURPOSE

PRIMARY-TO DETERMINE THE AMOUNT OF ALBEDO MEASURED IN TERMS OF SOLAR CELL CURRENT OVER DIFFERENT DEGREES OF LATITUDE. TO CONSTRUCT A MODEL OF THE EARTH'S ALBEDO.*** SECONDARY-WITH AN ACCURATE MAP OF THE EARTH ALBEDO, KNOWLEDGE OF THE ADDITIONAL POWER OBTAINABLE FROM ALBEDO COULD BE USED TO ENHANCE THE PERFORMANCE OF VARIOUS SPACECRAFT COMPONENTS, SUCH AS SOLAR CELLS.

31. PRINCIPLES OF OPERATION

THE SENSING UNIT WILL CONSIST OF TWO SOLAR CELLS. A TEMPERATURE SENSING THERMISTOR WILL BE LOCATED DIRECTLY UNDER THE SOLAR CELLS. ANY CHANGE IN TEMPERATURE WILL CAUSE A CHANGE IN THE THERMISTOR RESISTANCE AND, IN TURN, A CHANGE IN THE CURRENT FLOWING THROUGH THE OUTPUT RESISTOR. THE CURRENT OUTPUT FROM THE ALBEDO SENSING UNITS WILL BE FED THROUGH A RESISTOR SUCH THAT THE RESULTANT VOLTAGE IS 200 MILLIVOLTS FOR THE MAXIMUM ANTICIPATED INTENSITY OF THE EARTH ALBEDO. THE INTENSITY IS ASSUMED TO BE 50 PERCENT OF THAT OBTAINED BY INTEGRATING JOHNSON'S SPECTRUM, OR APPROXIMATELY 69 MILLIWATTS/SQUARE CENTIMETER. BASED ON A 126-MA OUTPUT CURRENT AT 200 MILLIVOLTS OF BARE (UNFILTERED) SOLAR CELL EXPOSED TO THE DIRECT SUNLIGHT (139.6 MW/SQUARE CENTIMETER), THE MAXIMUM OUTPUT OF THE SENSING UNIT WAS CALCULATED BY NUMERICAL INTEGRATION TO BE 60 MA. A DC AMPLIFIER WILL PROVIDE LINEAR AMPLIFICATION OF THE SENSOR SIGNALS TO THE -6.4 VOLT RANGE REQUIRED BY THE TELEMETRY SYSTEM.

32. PHENOMENA OBSERVED

REFLECTED SOLAR ENERGY

33. MEASUREMENT RANGE

ZERO TO 70 MILLIWATTS PER SQUARE CENTIMETER

34. PRECISION AND ACCURACY

0.3 TO 1.2 MICRONS NA

NA NA

NA NA

TWO SOLAR CELLS, AMPLIFIER

59. CALIBRATION	60. DATA RECOVERY	61. MISSION STATUS OBSERVATION
SELF-CALIBRATION	DELAYED TELEMETRY	EVERY 16 SECONDS

62. TELEMETRY REQUIREMENTS

DATA WILL CONSIST OF SENSING UNIT CURRENT AND THERMISTOR TEMPERATURE

63. ADVANTAGES AND LIMITATIONS

THE NIMBUS SPACECRAFT IS IDEAL FOR AN ALBEDO EXPERIMENT BECAUSE IT MAINTAINS ONE AXIS COINCIDENT WITH LOCAL VERTICAL.

64. REFERENCES

1) 'PROPOSAL FOR NIMBUS E ALBEDO MEASUREMENT EXPERIMENT, TECHNICAL SECTION, RCA ASTRO-ELECTRONIC DIVISION, FEB 68.

65. HISTORICAL REMARKS

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
ATMOSPHERIC DENSITY BY STELLAR REFRACTION	SRDM	E11
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0006

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
FISCHBACH, F.F.	U OF MICHIGAN	313-764-6565
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
BARTMAN, F.	U OF MICHIGAN	313-764-7210

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
NA	NA	NA	NA	INACT	PROPOSAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B.	NASA HDQTRS	OSSA/SRN	202-962-0891

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
U OF MICHIGAN	ANN ARBOR, MICHIGAN	NA	31 MONTHS

26. INSTRUMENT TYPE	27. SECURITY
STAR TRACKER, DOUBLE TELESCOPE IMAGE-DISSECTING PHOTOTUBE	UNC

28. APPLICATION	29. SPACECRAFT
MET	NIMBUS E

30. PURPOSE

PRIMARY-TO MEASURE THE VERTICAL PROFILES OF ATMOSPHERIC DENSITY, PRESSURE AND TEMPERATURE FOR COMPARISON WITH CONVENTIONAL MEASUREMENTS AND MEASUREMENTS OVER SPARSE DATA AREAS***SECONDARY-TO GATHER NIGHTTIME CLOUD-TOP-HEIGHTS STATISTICS, DATA ON BACKGROUND RADIANCE NEAR THE HORIZON, AND STARLIGHT ATMOSPHERIC ATTENUATION.

31. PRINCIPLES OF OPERATION

THE EXPERIMENT PROPOSES TO MEASURE THE REFRACTION OF STARLIGHT PASSING THROUGH THE ATMOSPHERE AT DIFFERENT ALTITUDES TO GIVE A VERTICAL DENSITY PROFILE.THE AMOUNT THAT LIGHT IS REFRACTED IS PROPORTIONAL TO THE DENSITY OF THE ATMOSPHERE.FROM THE DENSITY, THE PRESSURE AND TEMPERATURE CAN BE INFERRED.THE INSTRUMENT PROPOSED IS AN AUTOMATIC STAR-TRACKER,CONSISTING OF A DOUBLE TELESCOPE ASSEMBLY (SECTIONS A AND B) AND AN IMAGE-DISSECTING PHOTOTUBE. THE GIMBALLED TELESCOPE ASSEMBLY VIEWS THE HORIZON IN THE ORBITAL PLANE. UPON COMMAND THE TRACKER SCANS ACROSS 60 DEGREES IN AZIMUTH AND 8 DEGREES IN ELEVATION SEEKING A STAR EXCEEDING A PRE-SET BRIGHTNESS.UPON FINDING SUCH A STAR, IT IS TRACKED BY A SECOND TELESCOPE WITH A FIELD OF VIEW OF 17 ARC-MIN BY 17 ARC-MIN, UNTIL OCCULTATION BY THE EARTH.THE APPARENT ANGULAR DISPLACEMENT, WHICH IS A MEASURE OF THE REFRACTIVITY, IS THEN RECORDED.AFTER OCCULTATION THE PROCESS IS REPEATED.THE PERIOD OF TIME FOR ACQUISITION IS 5 TO 10 SECONDS,DEPENDING ON LOCATION OF BRIGHT STARS.TRACKING UNTIL OCCULTATION REQUIRES ONE TO THREE MINUTES DEPENDING UPON ELEVATION OF INITIAL ACQUISITION.

32. PHENOMENA OBSERVED

STARLIGHT PASSING THRU ATMOSPHERE

33. MEASUREMENT RANGE

DENSITY PROFILES BETWEEN EXTANT CLOUD TOPS AND 30 KM

34. PRECISION AND ACCURACY

1 TO 4 ARC-SEC RMS

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.3 TO 0.9 MICRONS	NA	

38. FIELD OF VIEW	39. GROUND SWATH
0.28 BY 0.28 DEG	NA

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		ANY	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

SATELLITE POSITION TO WITHIN ACCURACY OF THE TRACKING NETWORK

47. COMPONENTS

2 TELESCOPES/GYROSCOPES, IMAGE DISSECTOR PHOTOTUBE

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
44 LB	3.74 CU FT	18 WATTS	5 WATTS	35 WATTS	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
NONE	DELAYED TELEMETRY	DURING NIGHTTIME

62. TELEMETRY REQUIREMENTS

TOTAL BITS/DATA POINT=11 DIGITAL FOR SECTION B, AND 39 DIGITAL FOR SECTION A (10 SAMPLES/SECOND OR 390 BPS DIGITAL)

63. ADVANTAGES AND LIMITATIONS

CONTINUOUS WORLDWIDE MEASUREMENTS, LIMITED TO NIGHTTIME OPERATION AND ABOVE CLOUDS

64. REFERENCES

1) FISCHBACH, F.F.: PROPOSAL FOR STELLAR OCCULTATION-REFRACTION MEASUREMENTS, UNIV OF MICHIGAN, FEB 68.***2) FISCHBACH, F.F.: A SATELLITE METHOD FOR PRESSURE AND TEMPERATURE BELOW 24 KM, BULLETIN AMER MET SOCIETY, VOL 46 NO 9, SEPT 1965.

65. HISTORICAL REMARKS

66 DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
ATMOSPHERIC OZONE EXPERIMENT	ATOZ	E16
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
PALMER, C.E.	UNIV CALIFORNIA AT L.A.	213-272-8911
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
DUARDO, J. A.	ELECTRO-OPTICAL SYSTEMS	213-681-4671

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
NA	NA	NA	NA	INACT	PROPOSAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B. B.	NASA HDQTRS	OSSA/SRN	202-962-0891

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
ELECTRO-OPTICAL SYSTEMS	PASADENA, CALIFORNIA	NA	32 MONTHS

26. INSTRUMENT TYPE	27. SECURITY
SPECTROMETER, ULTRAVIOLET FIXED-GRATING POLYCHROMATOR	PRO

28. APPLICATION	29. SPACECRAFT
MET, ATM-PHYS	NIMBUS E

30. PURPOSE

PRIMARY-TO MEASURE ATMOSPHERIC OZONE BY MONITORING THE ATTENUATED SOLAR RADIATION IN THE MIDDLE UV AS THE SUN IS OCCULTED BY THE EARTH AND ITS ATMOSPHERE. THIS DATA IS IMPORTANT FOR THE ANALYSIS OF THE BUILDUP AND COLLAPSE OF THE POLAR STRATOSPHERIC VORTEX***SECONDARY-TO ACQUIRE DATA FOR ONE YEAR OVER BOTH POLAR CAPS TO BE THE BASE OF A NEW OZONE CLIMATOLOGY IN HIGH LATITUDES

31. PRINCIPLES OF OPERATION

THE SPECTROMETER WILL MONITOR THE ATTENUATED SOLAR RADIATION IN THE MIDDLE UV AS THE SUN IS OCCULTED BY THE EARTH AND ITS ATMOSPHERE.TEN DIFFERENT WAVELENGTHS(EACH OF 2.5 A BANDWIDTH) WILL BE ISOLATED BY THE SPECTROMETER, 2600,2750,2850, 2950,3050,3150, 3250,3350,3450, AND 3800 A.ALTHOUGH 9 WAVELENGTHS NEED TO BE MONITORED DURING ONE OCCULTATION ONLY 3 WAVELENGTHS WILL BE MONITORED AT ANY INSTANT.THE WAVELENGTHS WERE CHOSEN TO COMPLEMENT ONE ANOTHER, AS EACH WAVELENGTH GIVES INFORMATION IN ONLY ONE ALTITUDE RANGE. IN ADDITION, THE MONITORING OF 3800A WILL DETECT POSSIBLE ATTENUATION DUE TO AEROSOL AND DUST LAYERS OVER THE ENTIRE ALTITUDE RANGE FROM 50 TO 70 KM.A MEASUREMENT OF SOLAR INTENSITY MUST BE MADE AT A GIVEN WAVELENGTH WHEN THE SATELLITE IS IN AN UNOCCULTED POSITION TO CALIBRATE THE TOTAL INSTRUMENT RESPONSE FOR THE SOLAR IRRADIANCE AT THE GIVEN WAVELENGTH. A SIMILAR MEASUREMENT AT ANY POINT IN THE OCCULTED PORTION OF THE ORBIT THEN PROVIDES A TRANSMISSION MEASUREMENT FOR THE CORRESPONDING ATMOSPHERIC PATH.THE SATELLITE,DUE TO ITS ORBITAL MOTION, ACTUALLY VIEWS THE SUN THROUGH A CONTINUOUS NUMBER OF ATMOSPHERIC PATHS. AN OPTICAL IMAGE SLICING TECHNIQUE,REDUCING THE SUN TO A THIN HORIZONTAL LINE SOURCE, IS TO BE EMPLOYED.

32. PHENOMENA OBSERVED

ULTRAVIOLET SOLAR ENERGY ATTENUATED BY THE EARTH'S ATMOSPHERE

33. MEASUREMENT RANGE

OZONE PROFILES FROM 20-70 KM, FROM 60 TO 85 DEG N AND S LATITUDE

34. PRECISION AND ACCURACY

ALTITUDE WITHIN 5 KM;S/N=1000 FOR 2600 A WITH 1 INCH COLLECTOR

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
2600. TO 3800. A	0.208 PERCENT	

38. FIELD OF VIEW	39. GROUND SWATH
0.03 DEG	NA

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.03 DEG	NA

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

TIME AND DURATION OF OCCULTATION MUST BE PRECISELY KNOWN

47. COMPONENTS

SPECTROMETER, ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
16 LB	.7 CU FT		4 WATTS	12 WATTS	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
ONCE EVERY ORBIT	DELAYED TELEMETRY	TWICE PER ORBIT

62. TELEMETRY REQUIREMENTS

PRODUCES OUTPUT DURING A 36 SECOND INTERVAL, TWICE PER ORBIT. REQUIREMENT IS FOUR 10-BIT DIGITAL WORDS SAMPLED AT 1 SECOND INTERVALS FOR TOTAL OF 40 BITS/SECOND DURING 36 SECOND INTERVAL.

63. ADVANTAGES AND LIMITATIONS

OCCULTATION TECHNIQUE HAS UNIQUE ADVANTAGES IN TRACING HIGH ALTITUDE OZONE; ACCURATE POINTING REQUIRED.

64. REFERENCES

1) PALMER, C., ET AL: PROPOSAL FOR INVESTIGATION OF OZONE MEASUREMENTS IN THE TERRESTRIAL ATMOSPHERE, UCLA, JAN 68. ***2) PITTOCK, A., J.G.R., V. 68, P. 5143 (1963).***3) LIBBY, W.P., J.G.R., V. 65, P. 3307, (1960).

65. HISTORICAL REMARKS

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
BACKSCATTERED ULTRAVIOLET RADIATION EXPERIMENT	BUV	E15
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
HEATH, DR. D. F.	GODDARD SPACE FLT CENTER	301-982-6421
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
MATEER, DR. C. L.	NAT CNTR ATMOSPHERE RES	303-444-5151

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS	
NA	NA	NA	NA		INACT	PROPOSAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B. B.	NASA HDQTRS	OSSA/SRN	202-962-0891

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
		NA	

26. INSTRUMENT TYPE	27. RESOURCE TYPE
SPECTROMETER, TWO EBERT-FASTIE PHOTOMETRIC	PRO

28. APPLICATION	29. SPACECRAFT
MET, ATM-PHYS	NIMBUS E

30. PURPOSE

PRIMARY-TO PROVIDE SYSTEMATIC GLOBAL SCALE OBSERVATIONS OF THE SPATIAL DISTRIBUTION OF ATMOSPHERIC OZONE BY INVERSION OF MEASUREMENTS OF ULTRAVIOLET RADIATION BACKSCATTERED BY THE ATMOSPHERE.

31. PRINCIPLES OF OPERATION

THE PURPOSE OF THE EXPERIMENT IS ACCOMPLISHED BY INVERSION OF MEASUREMENTS OF SOLAR UV RADIATION BACKSCATTERED BY THE ATMOSPHERE AT 12 DIFFERENT WAVELENGTHS WITH A 10 ANGSTROM BANDPASS IN THE SPECTRAL REGION 2555-3398A.THE BACKSCATTERED RADIATION WILL BE MEASURED IN THE NADIR DIRECTION WHEN THE SATELLITE IS ON THE DAYLIGHT SIDE OF THE EARTH.TO PROVIDE CALIBRATION, THE DIRECT SOLAR RADIATION WILL BE MEASURED, BY USING A DIFFUSER PLATE TO REFLECT THE RADIATION INTO THE INSTRUMENT,AS THE SATELLITE ENTERS THE DARK ZONE. DETECTION OF THE RADIATION BACKSCATTERED IN THE 3125-3398 A SPECTRAL RANGE DURING NIGHTS OF FULL MOON WILL BE USED TO DEDUCE NIGHT TIME OZONE. AN INDEPENDENT DIFFUSER-PLATE MEASUREMENT OF DIRECT MOONLIGHT WILL BE ACCOMPLISHED AS THE SATELLITE EXITS FROM THE DARK ZONE. THE INSTRUMENT BASICALLY CONSISTS OF A DOUBLE(TANDEM) EBERT-FASTIE SPECTROPHOTOMETER WITH A 12-DEGREE FIELD OF VIEW AND A SLIT-WIDTH OF 10 ANGSTROMS, AND AN ANCILLARY NARROW-BAND INTERFERENCE FILTER PHOTOMETER. THE PHOTOMETER WILL BE ATTACHED TO THE INSTRUMENT TO MEASURE THE REFLECTIVITY OF THE GROUND-ATMOSPHERE SYSTEM IN THE SPECTRAL REGION FREE OF OZONE ABSORPTION. THE INSTRUMENT WILL RECORD A 50 A BAND CENTERED AT 3800 A.

32. PHENOMENA OBSERVED

BACKSCATTERED UV SOLAR RADIATION FROM ATMOSPHERE & LUNAR SURFACE

33. MEASUREMENT RANGE

HEIGHTS GREATER THAN 30 KILOMETERS

34. PRECISION AND ACCURACY

0.2 ANGSTROM

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
2555. TO 3800. A	0.0161 PERCENT	

38. FIELD OF VIEW	39. GROUND SWATH
12. DEG	NA

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
	NA

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

MAINTAIN LOW TEMPERATURE DIFFERENTIAL ACROSS SENSOR MODULE

47. COMPONENTS

SPECTROPHOTOMETER,FILTER PHOTOMETER, ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
35 LB	.75 CU FT	14 WATTS		20 WATTS	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
DIRECT SOLAR INPUT	DELAYED OR REALTIME	CONTINUOUS

62. TELEMETRY REQUIREMENTS

FOUR 10 BIT WORDS WILL BE REQUIRED FOR EACH 2.5 SEC READOUT OF ONE OF THE 12 WAVELENGTHS MEASURED

63. ADVANTAGES AND LIMITATIONS

SATELLITE METHODS MOST PRACTICAL FOR OBTAINING CONTINUOUS HIGH ALTITUDE OZONE MEASUREMENTS.

64. REFERENCES

1) HEATH D.F. AND MATEER, C.L.: PROPOSAL TO DETERMINE THE SPATIAL DISTRIBUTION OF ATMOSPHERIC OZONE FROM MEASUREMENTS OF UV RADIATION BACKSCATTERED BY THE EARTH'S ATMOSPHERE USING NIMBUS E, GSPC, FEB 68.***2) DAVE, J.V. AND MATEER, C.L., INTER SYMP ON ELECTROMAG SENSING OF EARTH FROM SATELLITES, POLYTECHNIC PRESS N.Y., NOV 65.

65. HISTORICAL REMARKS

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
GLOBAL RADAR FOR OCEAN WAVES AND WINDS	GRGW	E14
(TITLE CONT.)	4. RESUME DATE	5. VERS NO
	11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
PIERSON, DR. W.J.	NEW YORK UNIVERSITY	212-584-0700-526
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
MOORE, DR. R. K.	UNIVERSITY OF KANSAS	913-UN4-3441

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS	
NA	NA	NA	NA		INACT	PROPOSAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B. B.	NASA HDQTRS	OSSA/SRN	202-962-0891

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
NA	NA	NA	36 MONTHS

26. INSTRUMENT TYPE	27. SECURITY
SCATTEROMETER, TWIN 1.5-GHZ (20 CM) SIDE-LOOKING RADAR	PRO

28. APPLICATION	29. SPACECRAFT
MET, OCEAN	NIMBUS E

30. PURPOSE

PRIMARY-TO OBTAIN SCATTERING-CROSS-SECTION DATA FOR (1) CHARTING WAVE CHARACTERISTICS OVER THE WORLD OCEANS, (2) IMPROVING THE KNOWLEDGE OF SURFACE WIND FIELDS OVER THE OCEANS, AND (3) PREPARING REAL-TIME WAVE AND WIND FIELD FORECASTS***SECONDARY-TO EVALUATE THIS TYPE OF INSTRUMENT FOR OTHER APPLICATIONS.

31. PRINCIPLES OF OPERATION

THIS SIDE LOOKING RADAR SCATTEROMETER IS PROPOSED TO GATHER INFORMATION ABOUT THE WIND SPEED AT THE SURFACE OF THE WORLD'S OCEANS. THE SCATTEROMETER OPERATES BY MEASURING THE RADAR CROSS-SECTION OF A PATCH OF OCEAN. THE CROSS-SECTION IS GOVERNED, AT THE RADAR FREQUENCY CHOSEN, PRIMARILY BY THE DISTURBANCE OF THE OCEAN SURFACE DUE TO THE LOCAL WIND FIELD. HENCE THE OBSERVED VALUE CAN BE USED TO ESTABLISH THE WIND SPEED. MEASUREMENTS WILL BE MADE ON A 110 KM GRID EXTENDING TO EACH SIDE OF THE SUBSATELLITE PATH FROM ABOUT 400 KM OUT TO 1100 KM. THE PROPOSED SYSTEM USES TWO COLLAPSABLE 2.25 METER-LONG ANTENNAS. THE ANTENNAS ILLUMINATE A REGION TO EACH SIDE OF THE SATELLITE WITH ANGLES OF VARYING INCIDENCE. THE SYSTEM USES A 20 WATT PEAK POWER S-BAND (3000-4000 MHZ) TRANSMITTER. CROSS-TRACK RESOLUTION IS 20 KM WITH 3 BY 55 KM INTERVALS IN WHICH NO MEASUREMENT IS MADE. RANGE RESOLUTION IS ACHIEVED BY FREQUENCY MODULATION.

32. PHENOMENA OBSERVED

RETURNED RADAR ELECTROMAGNETIC ENERGY AT 3.00 GHZ

33. MEASUREMENT RANGE

WAVE HEIGHT FROM 1 TO 10 METERS; WIND SPEED FROM 6 TO 36 KNOTS

34. PRECISION AND ACCURACY

WIND SPEED WITHIN 1 KNOT

35. SPECTRAL RANGE		36. SPECTRAL RESOLUTION	37. TIME CONSTANT
3.00	GHZ	NA	

38. FIELD OF VIEW	39. GROUND SWATH
15. BY 2.55 DEG	600 KM BY 60 KM FROM 1400 KM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
2.55 DEG	60 KM FROM 1400 KM ALTITUDE AT 20 DEG INCIDENCE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
1.0 DEG	MED	SUN-SYNCH	RETROGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

RADAR SCATTEROMETER, 2 DEPLOYED 2.25 METER-LONG ANTENNAS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
90 LB	43. CU FT	35 WATTS	20 WATTS	45 WATTS	12 MON

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
SOURC/SEN		SENSITIVE		

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
NONE	DELAYED TELEMETRY	OVER OCEAN

62. TELEMETRY REQUIREMENTS

MINIMUM BIT RATE IS 336 KILOBITS PER ORBIT, MAXIMUM DATA RATE IS 3.672 MEGABITS PER ORBIT. HOUSEKEEPING MAY ADD 30 KILOBITS PER ORBIT.

63. ADVANTAGES AND LIMITATIONS

RADAR WAVELENGTH LONG ENOUGH TO GUARANTEE PENETRATION OF THE HEAVIEST CLOUDS AND RAIN, CHOSEN TO PERMIT CONTINUOUS COVERAGE

64. REFERENCES

1) PIERSON, W.J. AND MOORE, R.K. (PROPOSAL FOR GLOBAL RADAR FOR OCEAN WAVES AND WINDS, NYU AND U OF KANSAS, FEB 68.***2) MOORE, R.K. AND PIERSON, W.J.: INTERNATIONAL SYMP ELECTROMAG SENSING FROM SPACE, POLYTECHNIC PRESS, 1967.

65. HISTORICAL REMARKS

A SIMILAR INSTRUMENT HAS BEEN PROPOSED FOR NIMBUS F (RADSCAT)

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
HIGH-RESOLUTION FABRY-PEROT ETALON SPECTROMETER	HRES	E03
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
HOVIS, W. A. JR.	GODDARD SPACE FLT CENTER	301-982-6465
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
BLAINE, L. R.	GODDARD SPACE FLT CENTER	301-982-6465

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS	
NA	NA	NA	NA		INACT	PROPOSAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B. B.	NASA HDQTRS	OSSA/SRN	202-962-0891

22. VENDOR	23 LOCATION	24. FLIGHT DATE	25. LEAD TIME
NA	NA	NA	

26. INSTRUMENT TYPE	27. SECUR CL
INTERFEROMETER, HIGH-RESOLUTION 15-MICRON FABRY-PEROT ETALON	PRO

28. APPLICATION	29. SPACECRAFT
MET	NIMBUS E

30. PURPOSE

PRIMARY-TO DETERMINE THE VERTICAL TEMPERATURE STRUCTURE OF THE ATMOSPHERE FROM THE UPPER TROPOSPHERE TO THE STRATOSPHERE *** SECONDARY-TO COMBINE THESE MEASUREMENTS WITH THOSE OBTAINED FROM TROPOSPHERE SOUNDERS YIELDING INSIGHT INTO THE INTERACTION OF THE TROPOSPHERE AND STRATOSPHERE.

31. PRINCIPLES OF OPERATION

THE COMPENSATOR PLATE WILL BE TILTED THROUGH AN ANGLE OF APPROX 5 DEGREES PER SCAN. A SPECTRUM OF THE ATMOSPHERE WILL BE PRODUCED DIRECTLY WITH NO FOURIER TRANSFORM REQUIRED. THE INSTRUMENT WILL SCAN 60 RESOLVED ELEMENTS IN ONE SCAN. THE RECEIVED SIGNAL IS A MEASUREMENT OF THE TEMPERATURE. COMBINING THIS WITH A WEIGHTING FUNCTION RELATING WAVELENGTH OF THE SIGNAL TO ATMOSPHERIC PRESSURE GIVES THE TEMPERATURE AS A FUNCTION OF PRESSURE. THE SPECTROMETER WILL MONITOR TWO SPECTRUM INTERVALS; 14.9 TO 15.0 MICRONS FOR THE UPPER ATMOSPHERE, AND 14.0 TO 14.1 MICRONS FOR THE LOWER ATMOSPHERE.
NOTE - THE RADIATIVE COOLER AND ZERO LEVEL REFERENCE WILL REQUIRE A DEEP SPACE VIEW PERPENDICULAR TO THE ORBITAL PLANE.

32. PHENOMENA OBSERVED

THERMAL-IR ENERGY EMITTED BY THE ATMOSPHERE

33. MEASUREMENT RANGE

TEMPERATURE OF 190 TO 280 DEG K WITH S/N OF 100 AT 280 DEG K

34. PRECISION AND ACCURACY

35. SPECTRAL RANGE			36. SPECTRAL RESOLUTION	37. TIME CONSTANT
14.	TO 15.	MICRONS	0.20 PERCENT	

38. FIELD OF VIEW	39. GROUND SWATH
2.8 BY 2.8 DEG	NA

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
2.8 DEG	NA

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION

46. SPECIAL REQUIREMENTS

VIEW OF DEEP SPACE

47. COMPONENTS

INTERFEROMETER, COOLER

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
25 LB	0.67 CU FT	10 WATTS	3 WATTS		

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
			SENSITIVE	

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
BY GROUND COMMAND	DELAYED TELEMETRY	

62. TELEMETRY REQUIREMENTS

SAMPLING RATE DURING OPERATION WILL BE 12 SAMPLES PER SECOND, HOUSEKEEPING 1 SAMPLE PER SECOND WITH 10 BIT TELEMETRY, STORAGE WOULD BE NEEDED FOR 130 BITS PER SECOND.

63. ADVANTAGES AND LIMITATIONS

INCREASED SPECTRAL RESOLUTION - 0.002 MICRONS - EXTENDS PROFILE MEASUREMENT UPWARD TO 1-5 MILLIBAR(UPPER ATMOSPHERE) LEVEL.

64. REFERENCES

1) HOVIS, W.A., ET AL: PROPOSAL FOR A HIGH RESOLUTION FABRY-PEROT ETALON SPECTROMETER FOR 15 MICRON TEMPERATURE INVERSION, NASA GODDARD SPACE FLIGHT CENTER, CODE 622.***2) HILLEARY, ET AL: NATURE, 209, 489 (1965).***3) WARK AND FLEMING: MONTHLY WEATHER REVIEW, 94, 351 (1966).***4) WARK, ET AL: MONTHLY WEATHER REVIEW, 95, 468 (1967).

65. HISTORICAL REMARKS

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3 EXP NO
INFRARED INTERFEROMETER/SPECTROMETER	IRIS	E02
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
HANEL, R. A.	GODDARD SPACE FLT CENTER	301-982-4528
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
CONRATH, B. J.	GODDARD SPACE FLT CENTER	301-982-4235

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
NA	NA	NA	NA	INACT	PROPOSAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B. B.	NASA HDQTRS	OSSA/SRN	202-962-0891

22. VENDOR	23 LOCATION	24. FLIGHT DATE	25. LEAD TIME
GODDARD SPACE FLT CENTER	GREENBELT, MARYLAND	NA	42 MONTHS

26. INSTRUMENT TYPE	27. SECURITY
INTERFEROMETER, IR BEAM-SPLITTER MICHELSON SPECTROMETER	PRO

28. APPLICATION	29. SPACECRAFT
MET	NIMBUS E

30. PURPOSE

PRIMARY - TO DETERMINE VERTICAL ATMOSPHERIC TEMPERATURE PROFILES ON A GLOBAL BASIS *** TO OBTAIN SURFACE BRIGHTNESS TEMPERATURES WITHIN THE SPECTRAL REGION OF INTEREST.

31. PRINCIPLES OF OPERATION

THIS IS A TWYMAN-GREEN MODIFICATION OF A MICHELSON INTERFEROMETER SPECTROMETER OPERATING IN THE 5.0 TO 20 MICRON WAVELENGTH REGION WITH A FOV OF 8 DEGREES. RADIATION FROM A CYLINDER OF ATMOSPHERE, WHOSE BASE ON THE EARTH'S SURFACE IS A CIRCLE 80 NM IN DIAMETER, IS REFLECTED INTO THE INSTRUMENT FROM A PLANE MIRROR WHICH ROTATES TO PROVIDE IMC. THE RADIATION IS SPLIT INTO TWO BEAMS, ONE OF WHICH IS REFLECTED FROM A MOVING MIRROR, RECOMBINED AND FOCUSED ONTO A BOLOMETER DETECTOR. INTERFERENCE EFFECTS RESULT FROM THE PATH LENGTH DIFFERENCES IN THE 2 BEAMS S THE MIRROR MOVES. IT TRAVELS ABOUT 2 MM IN 11 SEC TO GIVE AN INTERFEROGRAM WHICH IS RECORDED ON TAPE. OBSERVATIONS ARE BEGUN 16 SEC APART IN WHICH TIME THE S/C TRAVELS ABOUT 65 NM. THUS THERE IS NO OVERLAP IN SUCCESSIVE OBSERVATIONS. AFTER RECORDING 14 INTERFEROGRAMS, 2 CALIBRATION OBSERVATIONS ARE MADE, ONE FOR A REFERENCE BLACKBODY AT 300 K AND ONE FOR OUTER SPACE. A FOURIER TRANSFORMATION, PERFORMED BY DIGITAL COMPUTER, MUST BE MADE ON EACH TELEMETERED INTERFEROGRAM TO PRODUCE A SPECTRUM. THEN, TO RELATE THIS TO ATMOSPHERIC CONDITIONS, APPROPRIATE SPECTRAL ABSORPTION REGIONS MUST BE CHOSEN AND EMPLOYED IN AN INVERSION OF THE RADIATIVE TRANSFER EQUATIONS

32. PHENOMENA OBSERVED

IR THERMAL EMISSION FROM THE EARTH BETWEEN 7 AND 22 MICRONS.

33. MEASUREMENT RANGE

34. PRECISION AND ACCURACY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
7.6 TO 22. MICRONS	0.139 PERCENT	

38. FIELD OF VIEW	39. GROUND SWATH
2.3 DEG	44 KM DIAM CIRCLE FROM 1100 KM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
2.3 DEG	44 KM FROM 1100 KM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

CRYOSTAT WITH 1 YEAR LIFETIME

47. COMPONENTS

OPTICAL MODULE WITH CRYOSTAT; ELECTRONIC, POWER SUPPLY MODULES

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
65 LB	4.32 CU FT	26 WATTS	5 WATTS	35 WATTS	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
			SENSITIVE	RADIATIVE COOLING

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
EVERY 15 AND 16 FRAME	DELAYED TELEMETRY	

62. TELEMETRY REQUIREMENTS

312.5 WORDS/SEC TO RECORDER; 2 CHANNEL RECORDER REQUIRED.

63. ADVANTAGES AND LIMITATIONS

GOOD SIGNAL TO NOISE RATIO, SHORT TIME CONSTANT *** EXTENSIVE CRYOGENIC COOLING REQUIRED, IMC REQUIRED.

64. REFERENCES

1) HANEL, R.A., ET AL: PROPOSAL FOR NIMBUS E INFRARED INTERFEROMETER SPECTROMETER, GSFC, FEB 68.

65. HISTORICAL REMARKS

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
INTERROGATION, RECORDING, AND LOCATION SYSTEM	IRLS	E25
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
HOGAN, G.	GODDARD SPACE FLT CENTER	301-972-6465
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
KLEINBERG, L.	GODDARD SPACE FLT CENTER	301-982-6465

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
NA	NA	NA	NA	INACT	PROPOSAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B.B.	NASA HDQTRS	OSSA/SRN	202-962-0891

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
GODDARD SPACE FLT CENTER	GREENBELT, MARYLAND	NA	

26. INSTRUMENT TYPE	27. SECURITY
DATA RELAY	PRO

28. APPLICATION	29. SPACECRAFT
NAV, MET, ERSP	NIMBUS E

30. PURPOSE

PRIMARY-TO EXTEND THE OPERATIONAL UTILITY OF THE IRLS SYSTEM BY DEVELOPING AND LAUNCHING A SMALL NUMBER OF BALLOON INTERROGATION PACKAGES FOR A LARGE SCALE WIND MEASUREMENT EXPERIMENT.*** SECONDARY-TO RELAY IRLS RANGING AND SENSOR DATA TO THE CENTRAL DATA PROCESSING FACILITY IN REALTIME VIA THE ATS F SATELLITE. RETURNING DATA TO THE IRLS GIVES A NAVIGATION CAPABILITY.

31. PRINCIPLES OF OPERATION

THE SAME IRLS SYSTEM FLOWN IN NIMBUS D WILL BE USED FOR THIS EXPERIMENT. TWO PARTS ARE ENVISIONES: (1) BALLOON EXPERIMENT - FIVE BALLOONS WILL BE LAUNCHED AT DIFFERENT LEVELS BETWEEN 20 AND 200 MILLIBARS WITH LIGHTWEIGHT, LOW-HAZARD IRLS PACKAGES. THE BALLOONS WILL BE INSTRUMENTED TO DETERMINE THE PERFORMANCE OF EACH COMPONENT COMPRISING THE BALLOON PACKAGE. THE NIMBUS E DATA-RELAY LINK WILL BE USED TO OBTAIN BALLOON POSITION IN REAL TIME. THE RANGE MEASUREMENT WILL ALSO BE STORED IN THE IRLS MEMORY FOR LATER READOUT; (2) NAVIGATION EXPERIMENT - FIVE NAVIGATION PLATFORMS WILL BE DEPLOYED. INTERROGATION OF A BUOY WILL BE PERFORMED BY NIMBUS E IN THE NORMAL MANNER. POSITION LOCATION OF THE BUOY WILL BE OBTAINED IN REAL TIME AND WILL BE PROVIDED TO THE USER AS REQUIRED. INITIATION OF THE RANGE MEASUREMENT WILL BE BY ONE OF THE OTHER FOUR NAVIGATING VEHICLES WHEN NIMBUS E IS IN VIEW. THE RANGE MEASUREMENT WILL BE RELAYED FROM NIMBUS E IN REALTIME TO THE DATA PROCESSING CENTER VIA THE ATS F. POSITION LOCATION COORDINATES WILL BE COMPUTED AT THE DATA PROCESSING CENTER, THEN RELAYED BACK TO THE NAVIGATING VEHICLE VIS ATS F DIRECTLY TO THE PLATFORM WITHIN 3 MINUTES OF INITIATION OF OPERATION.

32. PHENOMENA OBSERVED

DATA XMITTED FROM IRLS PACKAGES ON BALLOONS AND OTHER PLATFORMS

33. MEASUREMENT RANGE

34. PRECISION AND ACCURACY

LOCATION ACCURACY OF ABOUT 2 KM; NOISE FIGURE WILL BE ABOUT 4 DB

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
2.253 GHZ		

38. FIELD OF VIEW	39. GROUND SWATH
NA	NA

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
NA	NA

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
NA	NA	MED	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
SOURCE	NONE	NONE	NONE	NONE

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
NONE	REALTIME TELEMETRY	ON COMMAND

62. TELEMETRY REQUIREMENTS

370 INTERROGATIONS PER ORBIT (1000 BALLOONS GLOBAL), 160 BITS PER BALLOON PER INTERROGATION, READ INTO 100,000 BIT MEMORY, TRANSMITTED IN REAL TIME VIA ATS F SYNCHRONOUS SPACECRAFT TO GROUND

63. ADVANTAGES AND LIMITATIONS

64. REFERENCES

1) HOGAN, G. AND KLEINBERG, L.: PROPOSAL FOR A TECHNOLOGICAL NAV/MET EXPERIMENT BASED ON THE INTERROGATION RECORDING AND LOCATION SYSTEM FOR THE NIMBUS E SPACECRAFT.***2) FEASIBILITY OF GLOBAL OBSERVATION AND ANALYSIS EXPERIMENT, NAS PUB 1290.

65. HISTORICAL REMARKS

SPACECRAFT PACKAGE ESSENTIALLY THE SAME AS ON NIMBUS D

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
IONIZING-RADIATION EXPERIMENT	IONTEC	E33A
(TITLE CONT.)	4. RESUME DATE	5. VERSION
TISSUE-EQUIVALENT IONIZATION CHAMBER (TEIC)	11/10/69	0006

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
HOLLY, F.E.	AIR FORCE WEAPONS LAB	505-247-1711
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
HEWLETT, CAPT. T.	AIR FORCE WEAPONS LAB	505-247-1711

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
NA	NA	NA	NA	INACT	PROPOSAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B. B.	NASA HDQTRS	OSSA/SRN	202-962-0891

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
		NA	

26. INSTRUMENT TYPE	27. SECURITY
COUNTER, 3 DOSIMETRIC TISSUE-EQUIVALENT IONIZATION CHAMBER	UNC

28. APPLICATION	29. SPACECRAFT
BIOL	NIMBUS E

30. PURPOSE

PRIMARY-TO MEASURE THE LOSE RATES RESULTING FROM SOLAR FLARE PARTICLES HAVING ENERGIES GREATER THAN 17 MEV OVER THE GEOMAGNETIC POLES.***SECONDARY-TO MEASURE THE DOSE RATES RESULTING FROM GEOMAGNETICALLY TRAPPED PARTICLES OVER THE SOUTH ATLANTIC; TO PROVIDE DIRECT EXPERIMENTAL TESTS OF MISSION PLANNING COMPUTER CODES WHICH ARE PRESENTLY IN USE BY BOTH NASA AND THE USAF.

31. PRINCIPLES OF OPERATION

RADIOBIOLOGICAL EXPERIMENTS HAVE SHOWN THAT THE ENERGY DEPOSITION PER UNIT PATH LENGTH AND THE TOTAL ENERGY ABSORBED CAN BE DIRECTLY RELATED TO BIOLOGICAL EFFECT. THE TOTAL ENERGY DEPOSITED, OR DOSE, IS THE MOST IMPORTANT SINGLE FACTOR ASSOCIATED WITH THE RADIATION FIELD IN DETERMINING FUNDAMENTAL BIOLOGICAL EFFECTS. THE TISSUE EQUIVALENT IONIZATION CHAMBER (TEIC) IS AN EXTREMELY SENSITIVE DIRECT READING DOSIMETER CONSISTING OF A THIN-WALLED, GAS-FILLED SPHERICAL CAVITY. BOTH THE WALLS AND THE FILLING GAS ARE DESIGNED TO BE TISSUE EQUIVALENT. A SUBSTANCE IS TISSUE EQUIVALENT WHEN THE ATTENUATION AND ABSORPTION OF NUCLEAR RADIATION IN TISSUE IS CLOSELY DUPLICATED IN THE SAMPLE MATERIAL. THE CHAMBER IS POINTED AWAY FROM THE EARTH. THE CHARGE PRODUCED WITHIN THE CHAMBER BY INCOMING RADIATION FROM SPACE IS COLLECTED BY ELECTRODES AND AMPLIFIED BY AN ELECTROMETER-TYPE PREAMPLIFIER. THE SIGNAL IS THEN PROCESSED BY MAGNETIC AMPLIFIERS WHICH PRODUCE AN ANALOG OUTPUT OF 0 TO 5 VOLTS. EXACT DETAILS OF THE ANALOG TO DIGITAL CONVERTER AND BINARY STORAGE USED WILL DEPEND ON THE PAYLOAD DATA HANDLING EQUIPMENT.

32. PHENOMENA OBSERVED

SOLAR FLARE RADIATION AND COSMIC RADIATION OF GALACTIC ORIGIN.

33. MEASUREMENT RANGE

FLARE PROTONS 160/SEC/SQ CM MAX; COSMIC PARTICLES 2.5/SEC/SQ CM

34. PRECISION AND ACCURACY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT

38. FIELD OF VIEW	39. GROUND SWATH
180. DEG	NA

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
NA	NA

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
NA	NA	MED	POLAR NA

46. SPECIAL REQUIREMENTS

EXTENSIVE SHIELDING FROM ALL NUCLEAR RADIATION SOURCES ON NIMBUS

47. COMPONENTS

THREE IONIZATION CHAMBERS, SHIELDING

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
6 LB	0.07 CU FT	1 WATT			

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
		SENSITIVE		SEE ITEM 46

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
	DELAYED TELEMETRY	CONTINUOUS

62. TELEMETRY REQUIREMENTS

EACH OF 3 CHANNELS (ONE PER IONIZATION CHAMBER) SHOULD BE SAMPLED EVERY 4 SECONDS

63. ADVANTAGES AND LIMITATIONS

NO MOVING PARTS, REQUIRES NO WINDOW; WILL REQUIRE EXTENSIVE SHIELDING FROM ON-BOARD NUCLEAR RADIATION SOURCES

64. REFERENCES

1) PROPOSAL FOR AN IONIZING RADIATION EXPERIMENT ON THE NIMBUS-E MISSION, AFWL/USAF, MAR 68.***2) LANGHAM, W.: BIOLOGICAL EFFECTS OF IONIZING RADIATION, JOUR AEROSPACE MED, V. 36, 2, 1965. ***3) REAGAN, ET AL: PROTON-ELECTRON SPECTROMETER EXPERIMENTS ON GEMINI-4 AND GEMINI-7, FINAL REPORT CONTRACT NAS 9-1587, 1966.

65. HISTORICAL REMARKS

IONTEC AND IONLET ARE BOTH PART OF IONIZING-RADIATION EXPERIMENT

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
IONIZING-RADIATION EXPERIMENT	IONLET	E33B
(TITLE CONT.)	4. RESUME DATE	5. VERSION
LINEAR-ENERGY-TRANSFER SPECTROMETER (LET)	11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
HOLLY, F.E.	AIR FORCE WEAPONS LAB	505-247-1711
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
HEWLETT, CAPT. T.	AIR FORCE WEAPONS LAB	505-247-1711

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
NA	NA	NA	NA	INACT	PROPOSAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B. B.	NASA HDQTRS	OSSA/SRN	202-962-0891

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
		NA	

26. INSTRUMENT TYPE	27. SECURITY
SPECTROMETER, SOLID-STATE LINEAR-ENERGY-TRANSFER (LET)	UNC

28. APPLICATION	29. SPACECRAFT
BIOL	NIMBUS E

30. PURPOSE

PRIMARY-TO MEASURE THE LINEAR ENERGY TRANSFER SPECTRA RESULTING FROM SOLAR FLARE PARTICLES HAVING ENERGIES GREATER THAN 17 MEV OVER THE GEOMAGNETIC POLES.***SECONDARY-TO MEASURE THE LINEAR ENERGY TRANSFER SPECTRA RESULTING FROM GEOMAGNETICALLY TRAPPED PARTICLES OVER THE SOUTH ATLANTIC; TO PROVIDE DIRECT EXPERIMENTAL TESTS OF NASA AND USAF MISSION PLANNING COMPUTER CODES.

31. PRINCIPLES OF OPERATION

THE LINEAR ENERGY TRANSFER (LET) SPECTROMETER CONSISTS OF A SOLID STATE DETECTOR SYSTEM FOR DETERMINING THE NUMBER OF LOW ENERGY (HIGH LINEAR ENERGY TRANSFER) PARTICLES THAT COMPRISE THE BIOLOGICALLY SIGNIFICANT RADIATION DOSE. MEASUREMENTS WILL BE MADE TO DETECT RADIATION FROM TRAPPED PARTICLES IN THE VAN ALLEN BELTS, FROM PRIMARY COSMIC RADIATION, AND FROM POSSIBLE SOLAR FLARE CHARGED PARTICLES. PROTONS BELOW 18.5 MEV WILL BE ANALYZED ACCORDING TO ENERGY LOSS IN THE SOLID STATE DETECTOR AND PLACED INTO FIVE ENERGY CHANNELS: 18.5 - 14.0, 14.0 - 10.0, 10.0 - 6, 6 - 2, AND 2 - 0.5 MEV. ALPHA PARTICLES BETWEEN 18.5 AND 75 MEV WILL BE RECORDED IN A SEPARATE CHANNEL. ALPHA PARTICLES BELOW 18.5 MEV WILL BE EXTREMELY RARE COMPARED TO PROTONS AND WILL NOT BE SEPARATED FROM PROTON COUNTS OF THE SAME ENERGY RANGE. PROTONS WITH ENERGIES GREATER THAN 75 MEV WILL BE PROCESSED IN ONE CHANNEL OF LOW LET DATA TO PROVIDE INFORMATION ON THE NUMBER OF HIGH ENERGY PARTICLES THAT CREATED THE RADIATION DOSE. THE SYSTEM WILL MEASURE THE RANGE OF HIGH LET BETWEEN 28 AND 424 KILOELECTRON VOLTS/MICRON IN MUSCLE TISSUE AND ALSO RECORD ALL PARTICLES WITH LET VALUES LESS THAN 28 KILOELECTRON VOLTS/MICRON.

32. PHENOMENA OBSERVED

COSMIC,SOLAR FLARE, AND TRAPPED RADIATION IN THE VAN ALLEN BELTS

33. MEASUREMENT RANGE

LINEAR ENERGY TRANSFER FROM 28-424 KEV/MICRON IN MUSCLE TISSUE

34. PRECISION AND ACCURACY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.5 TO 75. MEV	SEE ITEM 31	

38. FIELD OF VIEW	39. GROUND SWATH
180. DEG	NA

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
NA	NA

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
NA	NA	MED	HIGH

46. SPECIAL REQUIREMENTS

0 TO 100 DEGREE F OPERATING TEMPERATURE RANGE DESIRED

47. COMPONENTS

SPECTROMETER

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
3 LB	0.07 CU FT	1 WATT			

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58 SHIELDING
	SENSITIVE			

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
	DELAYED TELEMETRY	CONTINUOUS

62. TELEMETRY REQUIREMENTS

7 CHANNELS OF DATA AND ONE TEMP CHANNEL WHICH SHOULD BE SAMPLED EVERY 16 SEC. THE DATA CHANNELS SHOULD BE SAMPLED EVERY 0.2 SEC ALTHOUGH ADJUSTMENT FOR LESS FREQUENT SAMPLING IS POSSIBLE.

63. ADVANTAGES AND LIMITATIONS

NO MOVING PARTS; LARGE UNOBSTRUCTED VIEWING ANGLE REQUIRED.

64. REFERENCES

1) PROPOSAL FOR AN IONIZING RADIATION EXPERIMENT ON THE NIMBUS-E MISSION, AFWL/USAF, MAR 68.***2) LANGHAM, W.: BIOLOGICAL EFFECTS OF IONIZING RADIATION, JOUR AEROSPACE MED, V. 36, 2, 1965. ***3) REAGAN, ET AL: PROTON-ELECTRON SPECTROMETER EXPERIMENTS ON GEMINI-4 AND GEMINI-7, FINAL REPORT CONTRACT NAS 9-1587, 1966.

65. HISTORICAL REMARKS

IONLET AND IONTEC ARE BOTH PART OF IONIZING-RADIATION EXPERIMENT

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
LIMB-RADIANCE INVERSION EXPERIMENT	LIRAIN	E01
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
BATES, J.C.	HONEYWELL AEROSPACE	612-331-4141
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
KING, DR. JEAN I.F.	GCA TECHNOLOGY DIVISION	617-275-9000

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
			01/69		PRELIM DSGN

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B. B.	NASA HDQTRS	OSSA/SRN	202-962-0891

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
SANTA BARBARA RES CENTER	GOLETA, CALIFORNIA	06/72	40 MONTHS

26. INSTRUMENT TYPE	27. SECURITY
RADIOMETER, 15-MICRON INFRARED SCANNING PRECISION	PRO

28. APPLICATION	29. SPACECRAFT
MET, ATM-PHYS	NIMBUS E

30. PURPOSE

PRIMARY-TO TEST INVERSION THEORIES FOR RADIANCE/TEMPERATURE MEASUREMENTS ALONG THE EARTH'S LIMB.***SECONDARY-TO PROVIDE DATA ON THE ATMOSPHERIC TEMPERATURE-ALTITUDE STRUCTURE ABOVE 30 KM ON A GLOBAL BASIS OVER AN EXTENDED PERIOD OF TIME. THIS DATA COULD PROVIDE A FIRST STEP TOWARD DEVELOPING LONG-RANGE WEATHER FORECASTING TECHNIQUES.

31. PRINCIPLES OF OPERATION

THE EXPERIMENT WILL CONSIST OF SPACEBORNE MEASUREMENTS OF RADIANCE ALONG A TANGENT TO THE EARTH'S SURFACE. THE MEASUREMENT WILL INCLUDE A RANGE OF ALTITUDES FROM 20 TO 80 KILOMETERS. THE EXPERIMENT WILL BE CARRIED OUT USING A PRECISION SCANNING RADIOMETER OPERATING IN THE 15-MICRON C02 BAND WITH A 2.3-MICRON BANDWIDTH AND A VERTICAL RESOLUTION OF APPROXIMATELY TWO KILOMETERS AT THE EARTH'S HORIZON (SCAN RATE = 1 HZ). A SIMPLE BUT ACCURATE ATTITUDE-DETERMINATION SYSTEM WILL BE USED TO FIX ACCURATELY THE LINE OF SIGHT OF THE RADIOMETER TO THE EARTH'S ACTUAL HORIZON. THIS SYSTEM WILL CONSIST OF A SUN-SENSOR-GYROSCOPE-UNIT ALLOWING LINE OF SIGHT TO BE DETERMINED WITH APPROXIMATELY TWO-KILOMETER RESOLUTION. THE INFRARED RADIOMETER SUBSYSTEM INCLUDES A SCANNING HEAD, OPTICAL SYSTEM, CHOPPER, DETECTOR (MERCURY-CADMIUM-TELURIDE), AND DETECTOR COOLER. THE DETECTOR IS OPERATED AT APPROXIMATELY LIQUID-NITROGEN TEMPERATURE, WHICH IS MAINTAINED BY MEANS OF A STORED-SOLID-METHANE COOLER. APPLYING INVERSION TECHNIQUES TO THE RADIOMETER DATA WILL YIELD A MORE ACCURATE TEMPERATURE-ALTITUDE STRUCTURE OF THE EARTH'S ATMOSPHERE ABOVE 25 KM THAN HAS BEEN OBTAINED PREVIOUSLY.

32. PHENOMENA OBSERVED

IR ENERGY EMITTED BY ATMOSPHERE ALONG LINE OF SIGHT

33. MEASUREMENT RANGE

A DYNAMIC RANGE OF 700 TO 1 (220 TO 270 DEGREES KELVIN)

34. PRECISION AND ACCURACY

TEMPERATURE WITHIN 5 CENTIGRADE DEGREES, ALTITUDE WITHIN 1 KM

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
14.0 TO 16.3 MICRONS	NA	

38. FIELD OF VIEW	39. GROUND SWATH
0.03 DEG	NA

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
NA	

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
1.0 DEG			

46. SPECIAL REQUIREMENTS

PRELAUNCH WARMUP;CIRCULAR ORBITAL WITHIN 50 KM

47. COMPONENTS

RADIOMETER;COOLER;ATTITUDE ALIGNMENT AND INTEGRATION ASSEMBLIES

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
66 LB		30 WATTS		62 WATTS	6 MON

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
			SENSITIVE	200 K DEG OUTER SHELL

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
BLACKBODY STANDARD	DELAYED TELEMETRY	2800 PROFILES/DAY

62. TELEMETRY REQUIREMENTS

DATA WILL BE RECORDED ON NIMBUS HIGH DATA RATE STORAGE SYSTEM (HDRSS).DATA TRANSMISSION IS ON S-BAND TO THE ALASKA AND ROSMAN TRACKING STATIONS.HOUSEKEEPING DATA IS TRANSMITTED ON VHF BEACON

63. ADVANTAGES AND LIMITATIONS

THE TEST OF INVERSION THEORIES WILL REQUIRE A SERIES OF SIMULTANEOUS TEMPERATURE SOUNDINGS ACQUIRED BY ROCKET PROBES.

64. REFERENCES

1) NIMBUS E LIMB RADIANCE INVERSION EXPERIMENT, TECHNICAL PROPOSAL, V.1, HONEYWELL AEROSPACE, FEB. 68.

65. HISTORICAL REMARKS

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
METEOR-FLASH ANALYSIS EXPERIMENT	MEFAN	E32
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0006

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
MASTRUP, F.N.	TRW SYSTEMS	213-679-8711-X6920
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
COUR-PALAIS, B.G.	NASA/MSC	713-483-2666

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
NA	NA	NA	NA	INACT	PROPOSAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B. B.	NASA HDQTRS	OSSA/SRN	202-962-0891

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
TRW SYSTEMS	REDONDO BEACH, CALIF.	NA	14 MONTHS

26. INSTRUMENT TYPE	27. SECURITY
RADIOMETER, 3-CHANNEL PASSIVE UV OPTICAL	PRO

28. APPLICATION	29. SPACECRAFT
ASTR	NIMBUS E

30. PURPOSE

PRIMARY-TO YIELD NEW QUANTITATIVE DATA ON FAR UV RADIATION FROM TERRESTRIAL METEORS. THE CHANNELS HAVE BEEN SELECTED TO LOOK FOR THE IRON, MAGNESIUM, AND SILICON COMPONENTS IN THE TOTAL METEOR RADIATION.*** SECONDARY-TO DETERMINE WHICH OF THE THREE CHANNELS PROVIDES BEST SIGNAL/NOISE RATIO FOR THE DETECTION OF METEORS.

31. PRINCIPLES OF OPERATION

THIS EXPERIMENT IS DESIGNED TO COUNT AND ANALYZE OPTICAL METEOR FLASHES ON THE NIGHT SIDE OF THE EARTH. OPTICAL DATA WILL BE RECORDED SIMULTANEOUSLY IN THREE WAVELENGTH BANDS 0.22-0.26, 0.26-0.30, AND 0.30-0.40 MICRONS USING A THREE CHANNEL RADIOMETER. THE OPTICAL OBSERVABLES, MAXIMUM METEOR INTENSITY, INTEGRATED METEOR INTENSITY, AND BACKGROUND INTENSITY WILL BE MEASURED IN ALL THREE WAVELENGTH BANDS. THE EXPERIMENT METHOD IS TO POINT THE WIDE FIELD OF VIEW, THREE-CHANNEL RADIOMETER STRAIGHT DOWN TOWARDS THE DARK EARTH. ALL CHANNELS ARE ALIGNED TO COVER NEARLY IDENTICAL FIELDS OF VIEW. THE RADIOMETER IS EXPECTED TO SENSE THE METEOR RADIATION AGAINST THE EARTH'S BACKGROUND (NIGHT GLOW) AND THE RADIOMETER ELECTRONICS WILL RECORD ELECTRICAL QUANTITIES PROPORTIONAL TO METEOR OBSERVABLES. ASIDE FROM THE THREE RADIOMETER SENSOR CHANNELS, THE EXPERIMENT PACKAGE INCLUDES AN IN-FLIGHT CALIBRATION LAMP AND A FOURTH RADIOMETER CHANNEL DESIGNED TO PROTECT THE RADIOMETER SENSOR CHANNEL AGAINST DAMAGE FROM EXCESSIVE BACKGROUND ILLUMINATION LEVELS. THE IN-FLIGHT CALIBRATION LAMPS ARE INTENDED TO CHECK FOR MAJOR CHANGES IN SENSOR CHANNEL CALIBRATION EVERY FIVE MINUTES DURING FLIGHT.

32. PHENOMENA OBSERVED

EMITTED UV RADIATION FROM METEORS TRAVELING THROUGH ATMOSPHERE

33. MEASUREMENT RANGE

EXPECTED METEOR COUNT RATE = 0.003 TO 0.012 METEORS/SECOND

34. PRECISION AND ACCURACY

MINIMUM SIGNAL TO NOISE = 5:1; MAXIMUM SIGNAL TO NOISE = 2600:1

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.22 TO 0.40 MICRON	NA	

38. FIELD OF VIEW	39. GROUND SWATH
30. BY 30. DEG	NA

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
NA	NA

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
10.0 DEG	10.0 DEG/SEC	MED	HIGH POSIGRADE

46. SPECIAL REQUIREMENTS

NO OPERATION DURING FULL MOON OR SIGNIFICANT AURORA ACTIVITY

47. COMPONENTS

RADIOMETER, CALIBRATION LAMP, ELECTRONICS ASSEMBLY

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
14 LB	0.41 CU FT	7 WATTS	3 WATTS	9 WATTS	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
	NONE	NONE	SENSITIVE	TEMP RANGE: -20 TO 45 C

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
2 SEC EVERY 5 MINUTES	DELAYED TELEMETRY	EVERY NIGHT ORBIT

62. TELEMETRY REQUIREMENTS

ANALOG TO DIGITAL CONVERSION OF OUTPUTS FROM THREE DATA CHANNELS (1 SAMPLE/10 SECONDS); ALSO EXPERIMENT STATUS, POWER SUPPLY STATUS, CALIBRATION LAMP STATUS, ELECTRONICS & SENSOR TEMPERATURE.

63. ADVANTAGES AND LIMITATIONS

64. REFERENCES

1) 'PROPOSAL TO THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION FOR A METEOR FLASH ANALYZER EXPERIMENT FOR NIMBUS, TRW SYSTEMS GROUP, FEB 68.

65. HISTORICAL REMARKS

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
MICROWAVE REFRACTION/OCCULTATION EXPERIMENT	MIRO	E10
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
LUSIGNAN, DR. B.	STANFORD UNIV	415-321-3300
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
DA ROSA, A.	STANFORD UNIV	415-321-3300

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
NA	NA	NA	NA	INACT	PROPOSAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B. B.	NASA HDQTRS	OSSA/SRN	202-962-0891

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
PHILCO-FORD		NA	

26. INSTRUMENT TYPE	27. SECURITY
TRANSPONDER, COHERENT MICROWAVE	PRO

28. APPLICATION	29. SPACECRAFT
MET	NIMBUS E

30. PURPOSE

PRIMARY-TO DETERMINE VERTICAL PROFILE OF DENSITY AND PRESSURE DOWN TO 400 MB WITHOUT WATER VAPOR INFORMATION, AND TO 600 MB WITH 10 PERCENT ACCURACY WATER VAPOR DATA.***SECONDARY - TO EVALUATE METHODS OF CORRECTING FOR WATER VAPOR BETWEEN 400 AND 700 MB.

31. PRINCIPLES OF OPERATION

MICROWAVES TRANSMITTED THROUGH THE ATMOSPHERE ARE REFRACTED WITH THE REFRACTION PROPORTIONAL TO THE ATMOSPHERIC DENSITY. TRANSMISSION OF A MODULATED CARRIER BETWEEN TWO CO-ORBITING SATELLITES SPACED SO THAT THE BEAM CUTS THE ATMOSPHERE AT A GIVEN HEIGHT PERMITS MEASUREMENT OF THE EFFECTS OF REFRACTION IN TERMS OF PATH LENGTH VARIATION, MODULATION PHASE VARIATION, AND ATTENUATION. AT LOW ALTITUDES THE RAY IS ALSO REFRACTED BY WATER VAPOR AND THIS EFFECT MUST BE SEPARATED FROM AIR DENSITY EFFECT. DENSITY PROFILES CAN BE CONVERTED TO PRESSURE PROFILES BY ASSUMING A GIVEN SCALE HEIGHT, BY INDEPENDENT TEMPERATURE PROFILES, OR BY USE OF EMPIRICAL ORTHOGONAL FUNCTIONS IN AN OPERATIONAL SYSTEM USING SEVERAL SUBSATELLITES. IN THE EXPERIMENT A SUBSATELLITE WITH A SLOW DRIFT RATE RELATIVE TO NIMBUS IS REQUIRED TO GIVE READINGS AT DIFFERENT ALTITUDES.

32. PHENOMENA OBSERVED

PATH LENGTH VARIATION, MODULATION PHASE, SIGNAL AMPLITUDE.

33. MEASUREMENT RANGE

PRESSURES OF 10 TO 300 MB; 600 MB WITH WATER VAPOR DATA

34. PRECISION AND ACCURACY

3 CM PATH LENGTH PRECISION AT 5 GHZ; 1 MB ACCURACY ABOVE 300 MB

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
5. GHZ	NA	NA

39. FIELD OF VIEW	39. GROUND SWATH
0.04 BY 35. DEG	1.5 KM BY 700 KM FROM 1100 KM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.04 DEG	1.5 KM FROM 1100 KM ALTITUDE

42. POINTING ACCURACY	45. POINTING RATE	44. ALTITUDE	45. INCLINATION
30. DEG	NA	POLAR	NA

46. SPECIAL REQUIREMENTS

SUBSATELLITE WITH TRANSPONDER

47. COMPONENTS

COHERENT PHASE LOCK TRANSPONDER, OSCILLATOR, PARABOLIC ANTENNA

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
20 LB	0.3 CU FT	21 WATTS			24 MON

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
SOURC/SEN: NONE				

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
IN CONJUNCTION W/GROUND	DELAYED TELEMETRY	EVERY 10 SECONDS

62. TELEMETRY REQUIREMENTS

NIMBUS EXPERIMENT DATA HANDLING SYSTEM

63. ADVANTAGES AND LIMITATIONS

VERTICAL PROFILE INDEPENDENT OF ATMOSPHERIC STATE; ACCURACY REQUIRES KNOWLEDGE OF WATER VAPOR BETWEEN 400 AND 600 MB.

64. REFERENCES

1) PROPOSAL FOR A MICROWAVE OCCULTATION EXPERIMENT ON NIMBUS E, STANFORD ELECTRONICS LABORATORIES.***2) STANFORD UNIV SPINMAP FINAL REPORT (1966).

65. HISTORICAL REMARKS

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
NEAR-INFRARED MULTIDETECTOR GRATING SPECTROMETER	NIRMUL	E04
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
SHAW, DR. J.H.	OHIO STATE UNIVERSITY	614-293-7968
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
CHAHINE, DR. M.T.	JET PROPULSION LAB	213-354-2144

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
NA	NA	NA	NA	INACT	PROPOSAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B.	NASA HDQTRS	OSSA/SRN	202-962-0891

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
JET PROPULSION LAB	PASADENA, CALIFORNIA	NA	36 MONTHS

26. INSTRUMENT TYPE	27. SECURITY
SPECTROMETER, NEAR-IR MULTIDETECTOR GRATING	PRO

28. APPLICATION	29. SPACECRAFT
MET	NIMBUS E

30. PURPOSE

PRIMARY-TO MEASURE (A) THE TEMPERATURE PROFILE OF THE ATMOSPHERE UP TO THE 1 MB LEVEL, (B) THE WATER-VAPOR DISTRIBUTION, (C) THE SURFACE OR CLOUD-TOP TEMPERATURE, (D) THE CLOUD AMOUNT IN THE FIELD OF VIEW, (E) THE EMISSION FROM AURORAL N AND OH IN THE AIRGLOW ON THE DARK SIDE OF THE EARTH *** SECONDARY-TO PROVE THE UTILITY OF THE PROPOSED INSTRUMENT.

31. PRINCIPLES OF OPERATION

RADIATION FROM THE EARTH IS COLLECTED BY A TELESCOPE AND REFLECTED BY A PLANE MIRROR ONTO THE ENTRANCE SLIT OF THE SPECTROMETER. JUST BEFORE REACHING THE SLIT, A TUNING-FORK CHOPPER INTERRUPTS THE RADIATION AT 300 CPS. THE DETECTORS RESPOND TO THE DIFFERENCES IN RADIANCE BETWEEN CHOPPER AND EARTH. KNOWLEDGE OF THE RADIANCE OF THE CHOPPER YIELDS THE ABSOLUTE VALUE OF THE EARTH RADIANCE. PART OF THE BEAM FALLS ON A PARABOLOIDAL EBERT MIRROR PLACED BEHIND THE SLIT. THE COLLIMATED RADIATION FALLS ON A 120 LINE PER MM GRATING. THE DIFFRACTED RADIATION IS REFLECTED BACK TO THE EBERT MIRROR AND FROM THERE TO THE SPECTRAL PLANE. THE SPECTRAL PLANE CONTAINS THE DETECTOR ASSEMBLY. ISOLATION FILTERS IN FRONT OF THE INDIVIDUAL DETECTORS REJECT ALL BUT THE DESIRED WAVELENGTHS WITH A REJECTION RATIO OF 10,000. EACH DETECTOR HAS AN OPTICAL ASSEMBLY CONSISTING OF A FIELD LENS AND A CONDENSING LENS IN WHICH THE DETECTING ELEMENT IS IMMERSED. THE DETECTOR SIGNAL PASSES THROUGH A PREAMP AND AN INTERMEDIATE AMPLIFIER. THE OUTPUT SIGNAL IS DEMODULATED SYNCHRONOUSLY WITH THE CHOPPER FREQUENCY AND THEN INTEGRATED FOR 10 SECONDS. ALL DETECTOR OUTPUTS ARE INTEGRATED SIMULTANEOUSLY AND THEN SAMPLED IN SEQUENCE.

32. PHENOMENA OBSERVED

RADIATION FROM EARTH AND ATMOSPHERE IN 1-6 MICRON REGION

33. MEASUREMENT RANGE

TEMP-SURFACE TO 1 MB LEVEL; WATER VAPOR 400 TO 1000 MB LEVEL

34. PRECISION AND ACCURACY

TEMPERATURE +- 20 PERCENT; CLOUD-TOP HEIGHT WITHIN 100 MB

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.9 TO 6.0 MICRONS		

38. FIELD OF VIEW	39. GROUND SWATH
3.4 BY 0.7 DEG	36 BY 7 NM FROM 600 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
3.4 DEG	36 BY 7 NM FROM 600 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
10.0 DEG	0.033 DEG/SEC	MED	POLAR NA

46. SPECIAL REQUIREMENTS

FIELD OF VIEW MUST BE CLEAR OF OBJECTS

47. COMPONENTS

SPECTROMETER OPTICS, DETECTOR, AMPLIFIERS, DEMODULATORS, FILTERS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
30 LB	2.5 CU FT	25 WATTS	8 WATTS	30 WATTS	

54. RFI INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
SOURC/SEN				SENSITIVE SHUTTERS AND COOLERS

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
ONCE EACH MINUTE	DELAYED TELEMETRY	CONTINUOUS

62. TELEMETRY REQUIREMENTS

MINIMUM BIT RATE=2000 BPS; TOTAL BITS PER ORBIT = 500,000. TWO DATA CHANNELS REQUIRED, ONE FOR CLOUD COVER DETECTORS AND ENGINEERING DATA AND ONE FOR THE 35 DETECTOR CHANNELS.

63. ADVANTAGES AND LIMITATIONS

NON-SCANNING(NO MOVING PARTS); CRITICAL TEMPERATURE CONTROL REQUIRED, SUN SHIELDING REQUIRED.

64. REFERENCES

1) SHAW, DR. J.H., ET AL: NEAR-INFRARED MULTIDETECTOR GRATING SPECTROMETER', OHIO STATE UNIVERSITY/JPL (1968) SPECTROMETER, OHIO STATE UNIVERSITY/JPL (1968).***2) KAPLAN, JOSA, V.49, 1004 (1959).***3) HILLEARY, ET AL, NATURE, 309, 489 (1967).***4) CHANEY, ET AL: APPLIED OPTICS, 6, 347, (1967).

65. HISTORICAL REMARKS

THIS PROPOSAL WAS UPDATED AND RESUBMITTED FOR NIMBUS F.

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
OCEAN-SURFACE-TEMPERATURE MICROWAVE RADIOMETER	OSTMR	E13
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0006

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
EWING, DR.G.C.	WOODS HOLE OCEANOGRAPHIC	617-548-1400-X237
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
JONES, A.C.	NORTH AMERICAN ROCKWELL	714-632-8111

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
NA	NA	NA	NA	INACT	PROPOSAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B. B.	NASA HDQTRS	OSSA/SRN	202-962-0891

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
NORTH AMERICAN ROCKWELL	DOWNEY, CALIFORNIA	NA	36 MONTHS

26. INSTRUMENT TYPE	27. REQUIRED
RADIOMETER, 2.7-GHZ GAIN-STABILIZED DICKE PASSIVE MICROWAVE	PRO

28. APPLICATION	29. SPACECRAFT
OCEAN, MET	NIMBUS E

30. PURPOSE

PRIMARY-TO MEASURE GLOBAL SEA SURFACE TEMPERATURE ON A SEMI-DIURNAL WEATHER SCHEDULE *** SECONDARY - TO SUPPORT MARINE METEOROLOGY AND OTHER COMMERCIAL AND PUBLIC ENTERPRISES BENEFITING FROM THESE SCIENTIFIC SERVICES.

31. PRINCIPLES OF OPERATION

A PASSIVE MICROWAVE RADIOMETER OPERATING AT 2.7 GHZ TO DETECT SEA SURFACE TEMPERATURE WITH A THERMAL RESOLUTION BETTER THAN 1 K DEGREE ABSOLUTE AND 0.1 DEGREE RELATIVE IS PROPOSED. THE RADIOMETER IS BASICALLY A SENSITIVE MICROWAVE RECEIVER WHICH RESPONDS TO THERMAL RADIATION INCIDENT UPON THE ANTENNA. THE SYSTEM CONSISTS OF A DICKE RADIOMETER MODIFIED FOR GAIN STABILIZATION AND CONTINUOUS CALIBRATION. RATHER THAN EMPLOYING A SINGLE REFERENCE TEMPERATURE, THE RADIOMETER IS SWITCHED BETWEEN TWO DIFFERENT REFERENCE SOURCES. THE REFERENCE SWITCH OPERATES AT ONE HALF THE DICKE SWITCH FREQUENCY SO THAT THE TWO REFERENCE TEMPERATURES ARE SEEN ON ALTERNATE OBSERVATIONS OF THE REFERENCE CHANNEL BY THE SYSTEMS. THE RADIOMETER WOULD YIELD OVER 1400 INDEPENDENT DATA POINTS FOR EACH COMPLETE SCAN OF THE EARTH. SUCH A DENSE NET OF OBSERVATIONS OVER THE WORLD'S OCEANS WOULD SIGNIFICANTLY INCREASE THE INFORMATION AVAILABLE, PARTICULARLY OVER INACCESSIBLE AND CLOUDY AREAS.

32. PHENOMENA OBSERVED

MICROWAVE ENERGY EMITTED BY THE OCEAN SURFACE

33. MEASUREMENT RANGE

RADIANT TEMPERATURE FROM 80 TO 120 DEGREES KELVIN

34. PRECISION AND ACCURACY

RADIANT TEMPERATURE: 1 DEG K ABSOLUTE; 0.1 DEG K RELATIVE

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
2.7 GHZ		

38. FIELD OF VIEW	39. GROUND SWATH
25.4 DEG	270 NM BY 270 NM FROM 600 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
25.4 DEG	270 NM FROM 600 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

TWO LARGE HORN ANTENNAS

47. COMPONENTS

ANTENNA, RADIOMETER

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
39 LB	1.6 CU FT	54 WATTS			

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
SENSITIVE				

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
CONTINUOUS SWITCHING	DELAYED TELEMETRY	OVER OCEAN

62. TELEMETRY REQUIREMENTS

EXPERIMENT DATA-1 SAMPLE EVERY 1.5 SECONDS, REFERENCE TEMPERATURE-1 SAMPLE EVERY 3 SECONDS, 6 CHANNELS OF HOUSEKEEPING DATA-1 SAMPLE EVERY SECOND; COMPATIBLE WITH NIMBUS HDRSS.

63. ADVANTAGES AND LIMITATIONS

HIGH THERMAL ACCURACY, SPATIAL-RESOLUTION OBTAINED IS LOW.

64. REFERENCES

1) EWING, G.C.: PROPOSAL FOR SATELLITE MICROWAVE RADIOMETRY TO SENSE THE SURFACE TEMPERATURE OF THE WORLD OCEANS, WHOI, FEB 68.
***2) VECCHIO, F.A.: EMISSION FROM THE ROUGH SEA, AUTONETICS TECHNICAL REPORT T7-2262/060, OCT 9, 1967.

65. HISTORICAL REMARKS

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
OZONE-CONCENTRATION VERTICAL PROFILE EXPERIMENT	OCVP	E17
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0006

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
BLAMONT, J.E.	SERVICE D'AERONOMIE	PARIS, FRANC
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
NONE	NA	

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
NA	NA	NA	NA	INACT	PROPOSAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B.	NASA HDQTRS	OSSA/SRN	202-962-0891

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
		NA	

26. INSTRUMENT TYPE	27. SECURITY
PHOTOMETER, TWO-CHANNEL SCANNING UV	PRO

28. APPLICATION	29. SPACECRAFT
MET, PLAN-ATM	NIMBUS E

30. PURPOSE

PRIMARY - TO DETERMINE THE OZONE DISTRIBUTION AND ITS VARIABILITY AT ALTITUDES GREATER THAN 40 KILOMETERS. TO DETERMINE OZONE CONCENTRATION DIFFERENCES BETWEEN NIGHTTIME AND DAYTIME.*** SECONDARY - TO DETERMINE MORE PRECISELY THAN NOW KNOWN THE CAUSE OF THE DAILY VARIATIONS IN OZONE DISTRIBUTION.

31. PRINCIPLES OF OPERATION

A SCANNING PHOTOMETER WILL BE USED TO MEASURE THE ANGULAR DISTRIBUTION OF THE INTENSITY OF THE LIGHT EMITTED BY THE ATMOSPHERE IN FRONT OF THE SATELLITE IN TWO WAVELENGTH REGIONS: 2500 AND 2850 ANGSTROMS. DURING THE NIGHT THE ATMOSPHERE EMITS THE HERZBERG OXYGEN BANDS AT AN ALTITUDE OF 95 KILOMETERS IN THE REGION 2300-3000 ANGSTROMS. THIS SOURCE OF LIGHT CAN BE ABSORBED BY OZONE SINCE THIS EMISSION TAKES PLACE IN THE MAXIMUM OF THE HARTLEY CONTINUUM. THE PHOTOMETER IS PLACED IN ORBIT ABOVE THE EMISSION AND THE OZONE LAYER. IF THE FIELD OF VIEW IS SCANNED WITH A VERTICAL RESOLUTION ON THE ORDER OF 10 MINUTES OF ARC FROM THE HORIZON TO AN ALTITUDE OF 110 KM (OVER 3 DEGREES) OVER A PERIOD OF TWENTY SECONDS, THE INTENSITY OF THE LIGHT ARRIVING FROM A GIVEN ANGLE WILL COME FROM TWO PARTS OF THE OXYGEN LAYER: (1) A PART NEAR THE SATELLITE, WHICH IS NOT USEFUL (2) A PART FAR AWAY FROM THE SATELLITE, WITH RAYS HAVING TRAVERSED THE OZONE LAYER OVER A GIVEN LENGTH. KNOWING THE INTENSITY OF THE INCOMING RADIATION, THE PATH LENGTH, AND THE ABSORPTION COEFFICIENT OF OZONE, THE OZONE CONCENTRATION CAN BE CALCULATED.

32. PHENOMENA OBSERVED

UV RADIATION EMITTED BY ATMOSPHERE

33. MEASUREMENT RANGE

34. PRECISION AND ACCURACY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
2500. TO 2850. A	0.214 PERCENT	

38. FIELD OF VIEW	39. GROUND SWATH
5.0 BY 3.0 DEG	NA

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.17 DEG	NA

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		HIGH	

46. SPECIAL REQUIREMENTS

47. COMPONENTS

PHOTOMETER USING ASCOP 541 F 08 18 SOLAR BLIND PHOTOMULTIPLIER

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
10 LB	.58 CU FT	5 WATTS			

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
CALIBRATION LIGHTS	DELAYED TELEMETRY	

62. TELEMETRY REQUIREMENTS

MAIN FRAME 4 ANALOG WORDS (FOR SIGNAL) AND 1 DIGITAL WORD (FOR STATUS). SUB-COMMUTATOR 2 ANALOG WORDS.

63. ADVANTAGES AND LIMITATIONS

64. REFERENCES

1) BLAMONT, J.E.: PROPOSAL FOR NIMBUS E, DETERMINATION OF THE VERTICAL PROFILE OF OZONE CONCENTRATION ABOVE 40 KM, SERVICE D'AERONOMIE DU C.N.R.S., FEB 68.

65. HISTORICAL REMARKS

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
RETURN-BEAM VIDICON CAMERA SYSTEM	RBV	E22
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0006

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
PARK, DR. A.B.	NASA HDQTRS	202-963-6523
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
WEINSTEIN, O.	GODDARD SPACE FLT CENTER	202-982-6679

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
NA	NA	NA		INACT	PROPOSAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B. B.	NASA HDQTRS	OSSA/SRN	202-962-0891

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
RCA ASTROELECTRONICS DIV	PRINCETON, NEW JERSEY	NA	

26. INSTRUMENT TYPE	27. SECURITY
IMAGER, HIGH-RESOLUTION 2-INCH RETURN-BEAM VIDICON (TV)	PRO

28. APPLICATION	29. SPACECRAFT
ERSP	NIMBUS E

30. PURPOSE

PRIMARY-TO OBTAIN COMPLETE DETAILED COVERAGE OF THE U.S. FOR EARTH RESOURCE APPLICATIONS.***SECONDARY-TO TEST THE OPERATION OF THE 2-INCH RETURN-BEAM VIDICON SYSTEM AND SUPPORTING SUB-SYSTEMS ABOARD A SPACECRAFT.

31. PRINCIPLES OF OPERATION

THE EXPERIMENT CONSISTS OF THREE 2-INCH RETURN-BEAM VIDICON (TV) CAMERAS BORESIGHTED IN THE SPACECRAFT TO VIEW A COMMON 100 BY 100 STATUTE MILE SWATH. EACH CAMERA WILL EMPLOY A SEPARATE SPECTRAL FILTER RESULTING IN AN IMAGE IN THREE 100 MILLIMICRON WIDE SPECTRAL BANDS WHICH ARE CENTERED ABOUT 535, 680, AND 760 MILLIMICRONS. THE REALISTIC GOAL FOR GROUND RESOLUTION IS 200 FEET. THIS REQUIRES A 2640-TV-LINE RESOLUTION AT 2:1 SCENE CONTRAST WHICH IS WELL WITHIN THE CAPABILITY OF THE SYSTEM. DURING OPERATION THE CAMERAS WILL BE SIMULTANEOUSLY EXPOSED AND THEN SEQUENTIALLY READ-OUT THROUGH A WIDE-BAND DATA LINK. A 100-MILE WIDE STRIP WILL BE OBTAINED BY TAKING SUCCESSIVE SETS OF PICTURES AT 22.5 SECOND INTERVALS. THE PRIME MODE OF DATA TRANSMISSION WILL BE DIRECT READOUT TO ROSMAN AND FAIRBANKS. IT IS ALSO PROPOSED THAT A WIDE-BAND VIDEO TAPE RECORDER CAPABLE OF STORING UP TO 30 MINUTES OF VIDEO DATA BE SUPPLIED AS AN AUXILIARY DATA HANDLING MODE TO ALLOW OBSERVATION OF AREAS NOT WITHIN THE RANGE OF A GROUND STATION. AFTER REDUCTION EACH 100 BY 100 MILE SCENE WILL BE AVAILABLE IN THE FORM OF THREE BLACK AND WHITE COLOR SEPARATION NEGATIVES.

32. PHENOMENA OBSERVED

RADIATION FROM THE SURFACE OF THE EARTH IN THE VISIBLE SPECTRUM

33. MEASUREMENT RANGE

DYNAMIC RANGE = 100 TO 1 AT 0.04 FCS; 13 LEVELS OF GRAY

34. PRECISION AND ACCURACY

S/N IS APPROX 37 DB AT 0.04 FCS WITHOUT APERTURE CORRECTION

35. SPECTRAL RANGE			36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.4	TO	0.83 MICRONS	NA	

38. FIELD OF VIEW	39. GROUND SWATH
10. BY 10. DEG	100 BY 100 STATUTE MILES FROM 496 NM ALT

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.004 DEG	200 FT FROM 496 NM ALT, 2 TO 1 CONTRAST, 3500 TV LINE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
1.0 DEG		MED	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

CRITICAL LAUNCH WINDOW REQUIREMENTS

47. COMPONENTS

3 TV CAMERAS, TAPE RECORDER

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
120 LB		52 WATTS	3 WATTS	282 WATTS	12 MON

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
	DELAYED AND REALTIME WHENEVER OVER U.S.	

62. TELEMETRY REQUIREMENTS

PRIME MODE WILL BE DIRECT READOUT TO EXISTING GROUND STATIONS. A 4 MHZ BW VIDEO TAPE RECORDER WILL ALLOW STORAGE OF UP TO 30 MINUTES OF IMAGER, SUBSEQUENTLY TRANSMITTED TO ALASKA OR ROSMAN

63. ADVANTAGES AND LIMITATIONS

THE ORBIT MUST BE PRECISELY KNOWN FOR THE SPACECRAFT TO FULFILL EXPERIMENT REQUIREMENTS.

64. REFERENCES

1) PARK, DR. A.B. AND WEINSTEIN, O.:PROPOSAL FOR A MULTISPECTRAL TV CAMERA SYSTEM EXPERIMENT FOR EARTH RESOURCES APPLICATION, USDA/GSFC.

65. HISTORICAL REMARKS

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
SIMPLIFIED DATA-COLLECTION EXPERIMENT	SDC	E26
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
CURRY, R.C.	RCA ASTRO-ELECTRONICS	609-448-3400
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
BROWN, I.	RCA ASTRO-ELECTRONICS	609-448-3400

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
NA	NA	NA	NA	INACT	PROPOSAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B. B.	NASA HDQTRS	OSSA/SRN	202-962-0891

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
RCA ASTRO-ELECTRONICS	PRINCETON, NEW JERSEY	NA	30 MONTHS

26. INSTRUMENT TYPE	27. SECURITY
DATA RELAY, L-BAND 400/466-MHZ	PRO

28. APPLICATION	29. SPACECRAFT
HYDR, ERSP	NIMBUS E

30. PURPOSE

PRIMARY-TO DEMONSTRATE SYSTEM FEASIBILITY USING ONE-TRACK OF THE EXISTING FIVE-TRACK NIMBUS HIGH-DATA-RATE STORAGE SUBSYSTEM (HDRSS) TAPE RECORDER FOR ON-BOARD STORAGE OF DATA TELEMETERED FROM EXISTING HYDROLOGY STATIONS WITHIN THE CONTINENTAL UNITED STATES.

31. PRINCIPLES OF OPERATION

THIS SATELLITE DATA COLLECTION SYSTEM WOULD, INITIALLY, PROVIDE TWICE A DAY CONTACT WITH TEN REMOTE HYDROLOGIC SENSOR STATIONS. THE SYSTEM CAN BE EXPANDED TO HANDLE UP TO 250 SENSOR STATIONS PER ORBIT. OPERATIONALLY, THE SYSTEM COULD ACCOMODATE 10,000 SENSOR STATIONS IN THE U.S. THE DATA WILL BE RECORDED ON ONE TRACK OF FIVE-TRACK HDRSS TAPE RECORDER ON-BOARD THE NIMBUS SPACECRAFT. TO MINIMIZE THE DEVELOPMENT COSTS ASSOCIATED WITH THE EXPERIMENT, A MEMORY WILL BE USED ON THE SPACECRAFT TO STORE THE ADDRESSES AND INTERROGATION TIMES OF THE SENSOR STATIONS THAT ARE TO BE INTERROGATED DURING THE NEXT ORBIT. EACH SENSOR STATION WILL BE INDIVIDUALLY INTERROGATED BY TRANSMITTING ITS UNIQUE ADDRESS FROM A 5-WATT SPACECRAFT TRANSMITTER VIA AN OMNI-DIRECTIONAL ANTENNA. ASSUMING THAT DATA FROM TEN DIFFERENT SENSORS IS TRANSMITTED, THE TOTAL TIME FROM SPACECRAFT INTERROGATION OF THE SENSOR PLATFORM TO THE COMPLETION OF ITS REPLY IS 0.11 SECONDS. THUS THE SPACECRAFT CAN INTERROGATE 9 PLATFORMS EVERY SECOND, OR ABOUT 3,300 PLATFORMS DURING A NORMAL CONTINENTAL UNITED STATES CONTACT.

32. PHENOMENA OBSERVED

DATA READOUT OF SURFACE HYDROLOGIC SENSORS

33. MEASUREMENT RANGE

INTERROGATION AND REPLY FROM 10000 STATIONS IN THE UNITED STATES

34. PRECISION AND ACCURACY

S/C RECEIVER NOISE FIGURE = 4 DB; DATA ACCURACY TO 1 PERCENT

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
NA	NA	

38. FIELD OF VIEW	39. GROUND SWATH
NA	NA

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
NA	NA

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED	HIGH RETROGRADE

46. SPECIAL REQUIREMENTS

REQUIRES ONE TRACK OF THE NIMBUS HDRSS TAPE RECORDER

47. COMPONENTS

TRANSMITTER, RECEIVER, SENSOR INTERROGATION ADDRESS MEMORY

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
10 LB	0.23 CU FT	1 WATT		25 WATTS	12 MON

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
SOURCE	NONE	NONE	NONE	NONE

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
NONE	DELAYED TELEMETRY	TWICE/DAY/STATION

62. TELEMETRY REQUIREMENTS

150 BITS PER GROUND STATION TRANSMITTED TO NIMBUS ON A 460 MHZ (L-BAND) CARRIER FREQUENCY. INTERROGATION CARRIER FREQUENCY IS 400 MHZ. DATA TRANSMITTED TO CDA STATION AT 32 TO 1 SPEED-UP.

63. ADVANTAGES AND LIMITATIONS

WORLD WIDE COVERAGE FOR 535,000 SENSORS COULD BE HANDLED BY HALF THE CAPACITY OF ONE TRACK OF THE 5 TRACK HDRS RECORDER.

64. REFERENCES

1) PROPOSAL FOR NIMBUS E SIMPLIFIED DATA COLLECTION EXPERIMENT, RCA/PRINCETON, FEB 68.

65. HISTORICAL REMARKS

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
SIMPLIFIED TELEVISION CAMERA	SIMTV	E24
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
NICHOLS, GRADY B.	SOUTHERN RESEARCH INST	205-323-6592-X361
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
HORN, JAMES E.	SOUTHERN RESEARCH INST	205-323-6592

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS	
NA	NA	NA	NA		INACT	PROPOSAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B.	NASA HDQTRS	OSSA/SRN	202-962-0891

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
SOUTHERN RESEARCH INST	BIRMINGHAM, ALABAMA	NA	30 MONTHS

26. INSTRUMENT TYPE	27. SECURITY
IMAGER, LINEAR-ARRAY SCANNING TELEVISION	PRO

28. APPLICATION	29. SPACECRAFT
MET	NIMBUS E

30. PURPOSE

PRIMARY - TO PROVE THE FEASIBILITY OF UTILIZING THE ORBITAL MOTION OF A SATELLITE AS THE VERTICAL SCANNING FUNCTION OF A SIMPLE TELEVISION SYSTEM WHICH UTILIZES PHOTODIODES AS THE SENSOR RATHER THAN A CONVENTIONAL VIDICON TUBE.

31. PRINCIPLES OF OPERATION

THE THREE-AXIS STABILIZED SPACECRAFT PROVIDES A PLATFORM FOR THE CAMERA SYSTEM. A LINEAR ARRAY OF PHOTODIODES DEPOSITED ON A SINGLE SUBSTRATE, TOGETHER WITH CAMERA OPTICS, SERVES AS THE SENSOR MECHANISM FOR THE CAMERA SYSTEM. EACH OF THE 500 PHOTODIODES IS SAMPLED ON ONE SECOND INTERVALS AND RESET FOR THE NEXT INTEGRATION PERIOD. THE LIGHT FROM A PORTION OF THE IMAGE OF THE CLOUD COVER FALLS ON EACH PHOTODIODE FOR A PERIOD OF ONE SECOND, DURING WHICH TIME THE SPACECRAFT MOVES A SURFACE DISTANCE OF SIX KILOMETERS. THIS PERIOD IS MADE TO COINCIDE WITH THE HORIZONTAL RESOLUTION OF THE 500 LINE TELEVISION SYSTEM DETERMINED BY 500 PHOTODIODES FOR AN EARTH COVERAGE OF 3000 KM. THE DATA FROM EACH PHOTODIODE IS MULTIPLEXED INTO AN ANALOG-TO-DIGITAL CONVERTER AND SUBSEQUENTLY INTO A DIGITAL RECORDER, PRIOR TO MAGNETIC TAPE RECORDING. THE SPACECRAFT IS INTERROGATED BY A GROUND STATION WHERE A COMPLETE ONE-ORBIT PHOTOGRAPH CAN BE REPRODUCED.
NOTE: COMPATIBILITY WITH APT EQUIPMENT ALLOWS REAL-TIME TRANSMISSION CAPABILITY.

32. PHENOMENA OBSERVED

WORLD WIDE CLOUD COVER

33. MEASUREMENT RANGE

IF DIGITIZED, THE VIDEO SIGNAL WILL PROVIDE 32 LEVELS OF GRAY

34. PRECISION AND ACCURACY

IF DIGITIZED, THE VIDEO SIGNAL WILL PROVIDE 32 LEVELS OF GRAY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.4 TO 0.7 MICRONS	NA	NA

38. FIELD OF VIEW	39. GROUND SWATH
110. BY 0.3 DEG	3000 KM WIDTH FROM 1112 KM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.311 DEG	6 KM FROM 1112 KM ORBITAL ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

TELEVISION CAMERA, ELECTRONICS, POWER SUPPLY ADAPTOR

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
6 LB	.09 CU FT	3 WATTS			

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
NONE	NONE	NONE	NONE	NONE

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
	DELAYED TELEMETRY	CONTINUOUS

62. TELEMETRY REQUIREMENTS

3.0 KILOBITS/SEC DIGITAL, OR 500 SAMPLES/SEC ANALOG

63. ADVANTAGES AND LIMITATIONS

THE DATA FROM THIS CAMERA SYSTEM WILL BE COMPATIBLE WITH EXISTING APT EQUIPMENT

64. REFERENCES

1) A SIMPLIFIED TELEVISION CAMERA FOR THE NIMBUS E SPACE FLIGHT, SOUTHERN RESEARCH INSTITUTE, FEB 68.

65. HISTORICAL REMARKS

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
SOLAR-CONSTANT EXPERIMENT	SOLCON	E19
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
MCKEOWN, D.	FARADAY LABS	714-459-2412
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
BOWYER, J.M.	KANSAS STATE UNIVERSITY	913-532-6011

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
NA	NA	NA	NA	INACT	PROPOSAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B.	NASA HDQTRS	OSSA/SRN	202-962-0891

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
		NA	

26. INSTRUMENT TYPE	27. SECURITY
HELIOMETER, HIGH-SENSITIVITY QUARTZ-CRYSTAL DIGITAL	PRO

28. APPLICATION	29. SPACECRAFT
MET, ATM-PHYS, ASTR	NIMBUS E

30. PURPOSE

PRIMARY-TO MEASURE IN SPACE THE ABSOLUTE VALUE OF THE SOLAR CONSTANT FREE OF ATMOSPHERIC ATTENUATION WITHIN 0.04 PERCENT. THESE DATA WILL PROVIDE A RECORD TO CORRELATE WITH WEATHER CYCLES, CHANGES IN ATMOSPHERIC DENSITY, AND SOLAR ACTIVITY.*** SECONDARY-TO MEASURE SHORT-TERM FLUCTUATIONS OF THE SOLAR CONSTANT TO A PRECISION OF 0.01 PERCENT.

31. PRINCIPLES OF OPERATION

A HELIOMETER (ACTUALLY A PYRHELIOMETER) WILL BE USED TO MEASURE THE ABSOLUTE VALUE OF THE SOLAR CONSTANT. TWO Y-CUT GOLD-PLATED QUARTZ CRYSTALS WILL BE EMPLOYED. ONE IS OVER-PLATED WITH BENZENE BLACK AND EXPOSED TO THE SOLAR RADIATION, AND THE OTHER IS ENCLOSED IN A THERMALLY STABILIZED CAVITY. THE CRYSTALS ARE INCORPORATED INTO OSCILLATOR CIRCUITS SUCH THAT THE SIGNAL OUTPUT FREQUENCY IS THE BEAT FREQUENCY OF THE TWO CRYSTALS. IN OPERATION, THE CRYSTAL LOCATED BEHIND A SHUTTER WOULD BE POINTED DIRECTLY TOWARD THE SUN WITH THE SHUTTER OPEN. UNDER THESE CIRCUMSTANCES, THE CRYSTAL WOULD REACH A STEADY-STATE EQUILIBRIUM TEMPERATURE. TO PROVIDE CALIBRATION, THE SHUTTER WOULD PERIODICALLY MOVE A PLANE MIRROR IN FRONT OF THE HELIOMETER, DIRECTING ITS VIEW TOWARD SPACE. ELECTRICAL POWER WOULD THEN BE DISSIPATED IN THE GOLD PLATING ON THE CRYSTAL. THIS DISSIPATED POWER IS A MEASURE OF THE SOLAR CONSTANT. MEASUREMENTS OF SHORT-TERM FLUCTUATIONS WOULD BE MADE WITH THE SECOND QUARTZ-CRYSTAL HELIOMETER WITHOUT THE USE OF A SHUTTER. THE CRYSTAL WOULD BE POINTED DIRECTLY TOWARD THE SUN. FLUCTUATIONS IN THE CALIBRATION POWER OF THE HELIOMETER WOULD REFLECT SHORT-TERM FLUCTUATIONS IN SOLAR RADIATION.

32. PHENOMENA OBSERVED

TOTAL SOLAR POWER PASSING THROUGH THE INSTRUMENT APERTURE

33. MEASUREMENT RANGE

DYNAMIC RANGE = 0.00001 TO 1.0 WATTS PER SQUARE CENTIMETER

34. PRECISION AND ACCURACY

ABSOLUTE VALUE=0.04 PERCENT;SHORT-TERM FLUCTUATIONS=0.01 PERCENT

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
NA	NA	

38. FIELD OF VIEW	39. GROUND SWATH
NA	NA

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
NA	NA

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

MUST BE POINTED AT SUN

47. COMPONENTS

TWO HELIOMETERS; 4 Y-CUT CRYSTALS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
5 LB	.25 CU FT	3 WATTS			

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
NONE				

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
CONTINUOUS	DELAYED TELEMETRY	DAYSIDE OF ORBIT

62. TELEMETRY REQUIREMENTS

RAW TELEMETRY DATA WILL CONSIST OF TIME, FREQUENCY, AND CALIBRATION POWER FROM THE TWO HELIOMETERS ACQUIRED AT THE RATE OF 25 BITS PER SECOND.

63. ADVANTAGES AND LIMITATIONS

IMPROVED ACCURACY, WIDE DYNAMIC RANGE, AND DIGITAL OUTPUT

64. REFERENCES

1) MCKEOWN, D. AND BOWYER, J.: PROPOSAL TO MEASURE THE SOLAR CONSTANT - ABSOLUTE VALUE AND SHORT TERM FLUCTUATION, FARADAY LABS, FEB 68.***2) BRANDENBERG, W., CLAUSEN, O., ET AL, JOUR OPT SOC AMER, V. 56, NO. 80 (1966).***3) THEAEKARA, M.P.: THE SOLAR CONSTANT AND SPECTRAL DISTRIBUTION OF SOLAR RADIANT FLUX, SOLAR ENERGY, VOL 9, NO. 1;7 (1965).

65. HISTORICAL REMARKS

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
SOLAR X-RAY EMISSION EXPERIMENT	SOLXEM	E08
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
WALKER, A. B. C. JR.	AEROSPACE CORPORATION	
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
NA	NA	NA	NA	INACT	PROPOSAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B.	NASA HDQTRS	OSSA/SRN	202-962-0891

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
AEROSPACE CORPORATION	LOS ANGELES, CALIFORNIA	NA	

26. INSTRUMENT TYPE	27. SECURITY
SPECTROMETER, 1 ROCKING AND 1 SCANNING BRAGG CRYSTAL X-RAY	PRO

28. APPLICATION	29. SPACECRAFT
MET	NIMBUS E

30. PURPOSE

PRIMARY-TO OBSERVE THE SOLAR X-RAY SPECTRUM BETWEEN 1-25A WITH SUFFICIENT SPECTRAL AND SPATIAL RESOLUTION TO CONSTRUCT TIME HISTORIES AND SPATIAL MAPS DURING X-RAY FLARES AND X-RAY EMISSION ASSOCIATED WITH PLAGE REGIONS OF SUN *** SECONDARY - TO DETERMINE THE ATMOSPHERIC DENSITY BETWEEN 60 AND 250 KM BY OBSERVING THE EXTINCTION OF X-RAY LINES BY THE ATMOSPHERE.

31. PRINCIPLES OF OPERATION

IN ORDER TO STUDY THE EMISSION LINE PROFILES OF X-RAY EMISSION LINES ACROSS THE SOLAR DISK A NUMBER OF BRAGG CRYSTAL SPECTROMETERS WILL BE USED. IF AN EMISSION LINE PROFILE HAS A DISTINCT STRUCTURE ACROSS THE SOLAR DISK (DUE TO SEVERAL DISCRETE SOURCES) AND BEYOND THE LIMB, THE RESPONSE OF THE INSTRUMENT AS IT SCANS WILL REFLECT THIS STRUCTURE. THE ANGULAR RESOLUTION WILL DEPEND ON THE NATURAL LINE WIDTH OF THE CRYSTAL AND THE FREQUENCY WITH WHICH THE SPECTROMETER OUTPUT IS SAMPLED. IN MOST CASES THE SAMPLING RATE AND CRYSTAL LINE WIDTH WILL LIMIT THE RESOLUTION TO A FEW MINUTES. POINTING ERRORS WILL BE NEGLIGIBLE WITH RESPECT TO THIS RESOLUTION. IF THERE IS A SECOND STRONG EMISSION LINE WITH A BRAGG ANGLE WITHIN ONE DEGREE THEN THE UNFOLDING OF THE ANGULAR DISTRIBUTION OF EACH LINE WILL BE COMPLICATED BUT WILL NOT BE IMPOSSIBLE. IN ADDITION TO THE ROCKING CRYSTAL SPECTROMETERS, A KAP SPECTROMETER(8 TO 25 A) WILL SCAN THE ENTIRE REGION IN ORDER TO PROVIDE AN OVERALL MONITOR OF THE TOTAL ENERGY IN THIS SPECTRAL REGION, TO AID IN THE INTERPRETATION OF THE DATA FROM THE ROCKING CRYSTAL SPECTROMETERS, AND TO STUDY WITH LESSER TIME AND SPATIAL RESOLUTION THOSE LINES NOT SELECTED FOR DETAILED STUDY.

32. PHENOMENA OBSERVED

X-RAY EMISSION FROM THE SUN IN THE 1 TO 25 ANGSTROM REGION

33. MEASUREMENT RANGE

DYNAMIC RANGE = 30,000

34. PRECISION AND ACCURACY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
1. TO 25. A		

38. FIELD OF VIEW	39. GROUND SWATH
NA	NA

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.05 DEG	ABOUT 80,000 MILES ON THE SOLAR DISK

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION

46. SPECIAL REQUIREMENTS

EARTH-ORIENTED STABILIZED PLATFORM; USES SOLAR POINTER

47. COMPONENTS

SOLAR POINTER, SCANNING AND ROCKING SPECTROMETERS, ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
26 LB		7 WATTS		8 WATTS	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
NONE	SENSITIVE	SENSITIVE	SENSITIVE	0-40 DEG; 0-1 GAUSS

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
PE 55 X-RAY SOURCE	DELAYED TELEMETRY	DAYSIDE OF ORBIT

62. TELEMETRY REQUIREMENTS

300 BPS FOR DATA AND HOUSEKEEPING

63. ADVANTAGES AND LIMITATIONS

COMBINES TECHNIQUES OF BRAGG DIFFRACTION WITH GRAZING INCIDENCE OPTICS ALLOWING MONITORING OF A NUMBER OF SOLAR X-RAY LINES

64. REFERENCES

1) WALKER, A.B.C.,JR.: SOLAR X-RAY SPECTRUM BELOW 25 ANGSTROMS, AEROSPACE CORPORATION, FEB 68.***2) NEUPERT, ET AL: ASTROPHYS. J. LETTERS, 149, 273 (1967).

65. HISTORICAL REMARKS

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
TRACKING AND DATA RELAY EXPERIMENT	TDR	E28
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0006

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
PICKARD, R. H.	GODDARD SPACE FLT CENTER	301-982-6682
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
HEFFERNAN, PAUL	GODDARD SPACE FLT CENTER	

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
PROPOSAL					PROPOSAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B.	NASA HDQTRS	OSSA/SAN	202-962-0891

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
GODDARD SPACE FLT CENTER	GREENBELT, MARYLAND		

26. INSTRUMENT TYPE	27. SECURITY
DATA RELAY, REAL-TIME S-BAND	PRO

28. APPLICATION	29. SPACECRAFT
ERSP	NIMBUS E

30. PURPOSE

PRIMARY-TO DEFINE AND RESOLVE THE TECHNOLOGICAL PROBLEMS IMPOSED BY A TWO-WAY REAL TIME DATA RELAY LINK FROM THE NIMBUS SPACECRAFT THROUGH THE ATS SATELLITE TO A GROUND BASED DATA ACQUISITION FACILITY.*** SECONDARY-TO DEMONSTRATE THE TECHNOLOGICAL UTILITY OF A COMMAND LINK AND OF TWO-WAY DATA TRANSMISSION AT S-BAND OVER APPROXIMATELY 70% OF THE NIMBUS ORBIT.

31. PRINCIPLES OF OPERATION

THE ELEMENTS OF THE EXPERIMENT ARE: (1) AN ATS DATA ACQUISITION FACILITY (DAF), (2) THE ATS-F SYNCHRONOUS SATELLITE OPERATING AS A REPEATER/RELAY, AND (3) A NIMBUS-E SATELLITE WITH THE FOLLOWING EQUIPMENTS: ANTENNA WITH CONTROL AND DRIVE SYSTEM, GRARR TRANSPONDER, NIMBUS-ATS DATA MULTIPLEXER, AND TWT POWER SIMPLIFIERS. THE DATA MULTIPLEXER RECEIVES SIGNALS FROM THE ONBOARD EXPERIMENTS, SENSORS, TELEMETRY DEVICES, ETC. THE DATA MULTIPLEXER TRANSLATES THE SEPARATE INPUT SIGNALS IN FREQUENCY ACCORDING TO A PRESCRIBED FREQUENCY-DIVISION MULTIPLEX (FDM) SCHEME FOR PHASE MODULATION ONTO AN RF CARRIER. THE MODULATED SIGNAL IS FURTHER TRANSLATED IN FREQUENCY TO 2253 MHZ BY THE UP-CONVERTER AND THEN BROUGHT TO AN OUTPUT POWER LEVEL OF ABOUT TEN WATTS BY THE TWT AMPLIFIER. THE TWT FEEDS THE DIRECTIONAL S-BAND ANTENNA. THE SIGNAL TRANSMITTED BY NIMBUS WILL BE RECEIVED AT THE ATS BY THE S-BAND RECEIVER. THE RECEIVED SIGNAL WILL BE TRANSLATED TO AN INTERMEDIATE FREQUENCY, DOWN-CONVERTED BY 450 MHZ, AMPLIFIED TO A POWER LEVEL OF TEN WATTS, AND FED TO AN EARTH-COVERAGE S-BAND ANTENNA FOR TRANSMISSION TO THE DAF.

32. PHENOMENA OBSERVED

DATA FROM ONBOARD EXPERIMENTS, SENSORS, TELEMETRY SYSTEMS, ETC.

33. MEASUREMENT RANGE

S-BAND

34. PRECISION AND ACCURACY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
2.253	NA	NA

38. FIELD OF VIEW	39. GROUND SWATH
NA	NA

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
NA	NA

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
1.0 DEG	0.17 DEG/SEC	MED	

46. SPECIAL REQUIREMENTS

47. COMPONENTS

TRANSPONDER, POWER AMPLIFIER, MULTIPLEXER, ANTENNA SYSTEM

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
48 LB	1.2 CU FT	44 WATTS			

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
SOURC/SEN			SOURCE	

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
	REALTIME TELEMETRY	AS NEEDED

62. TELEMETRY REQUIREMENTS

ATS-F NIMBUS E COMMAND LINK PROPOSED AT 149 MHZ OR 1.8 GHZ. NIMBUS-STADAN RANGE, RANGE RATE, AND DATA LINK PROPOSED AT 2.2 GHZ AND 1.8 GHZ.

63. ADVANTAGES AND LIMITATIONS

THE EXPERIMENT PROVIDES FOR THE DIRECT RELAY OF NIMBUS E DATA, HENCE DEPENDENCE ON THE RECORDERS CAN BE LESSENED.

64. REFERENCES

1) COTE, C., ET AL: A PROPOSAL FOR A TECHNOLOGY EXPERIMENT - NIMBUS E DATA RELAY LINK THROUGH ATS-F, GSFC, MAR 68.

65. HISTORICAL REMARKS

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
VISIBLE-RADIATION POLARIZATION EXPERIMENT	VRP	E20
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
SEKERA, DR. Z	UNIV CALIFORNIA, L.A.	213-825-4134
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
HARIHARAN, DR. T.A.	UNIV CALIFORNIA, L.A.	213-825-4445

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
NA	NA	NA	NA	INACT	PROPOSAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B.	NASA HDQTRS	OSSA/SRN	202-962-0891

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
		NA	36 MONTHS

26. INSTRUMENT TYPE	27. SECURITY
POLARIMETER, ELECTROMECHANICAL 4-CHANNEL PHOTOMULTIPLIER	PRO

28. APPLICATION	29. SPACECRAFT
MET. ATM-PHYS	NIMBUS E

30. PURPOSE

PRIMARY-TO DETERMINE ATMOSPHERIC PARAMETERS SUCH AS AEROSOL CONTENT, CONCENTRATION, DISTRIBUTION,AND TURBIDITY BY ACQUIRING AND ANALYZING DATA ON THE INTENSITY AND POLARIZATION OF LIGHT EMERGING FROM THE EARTH'S ATMOSPHERE IN THE VISIBLE REGION FOR A RANGE OF ANGLES OF VIEW AND VARIOUS SUN ANGLES.

31. PRINCIPLES OF OPERATION

THE POLARIMETER IS DESIGNED TO MEASURE THREE OF THE FOUR STOKES PARAMETERS I, Q, AND U OF THE EMERGENT RADIATION FLUX FROM THE EARTH'S SURFACE BY COMPARING POLARIZED BEAMS WITH UNPOLARIZED BEAMS. COMPARISON IS ACCOMPLISHED BY AN ELECTROMECHANICALLY DRIVEN BEAM SELECTOR WHEEL WHICH IS PLACED IN THE FOCAL PLANE OF THE THREE COLLIMATING LENSES. MEASUREMENTS WILL BE MADE IN FOUR SELECTED SPECTRAL REGIONS,3800,4400,5000, AND 5800 A, USING APPROPRIATE FILTERS. ONE SET OF STOKES PARAMETERS IN EACH OF THE 4 SPECTRAL BANDS WILL BE OBTAINED EACH SECOND. PROVISION WILL BE MADE FOR AN ADEQUATE DYNAMIC RANGE BY BOTH OPTICAL AND ELECTRONIC MEANS. A SINGLE PHOTOMULTIPLIER TUBE WILL BE USED AS THE DETECTOR. INFLIGHT CALIBRATION WILL BE ACCOMPLISHED BY DIRECT VIEWING OF THE SUN THROUGH A FILTER SEVERAL TIMES DURING THE MISSION AND BY A 12 WATT TUNGSTEN-IODINE LAMP PRECEDING AND FOLLOWING EACH TARGET OBSERVATION. THE INSTRUMENT WILL TRACK A TARGET ON THE EARTH SURFACE AND A SCAN MECHANISM WILL TAKE INTO ACCOUNT THE EFFECTS OF ORBITAL INCLINATION, PRECISION ADJUSTMENTS, ECCENTRICITY, PERIOD, TARGET LATITUDE AND HEIGHT, AND THE EARTH'S OBLATENESS. A MINIMUM OF 100 SCANS AT 6 MINUTES PER SCAN WILL BE MADE.

32. PHENOMENA OBSERVED

INTENSITY AND POLARIZATION OF VISIBLE LIGHT FROM THE ATMOSPHERE

33. MEASUREMENT RANGE

DYNAMIC RANGE = 0.00082 TO 0.013 WATTS/SQ CM/MICRON/STERADIAN

34. PRECISION AND ACCURACY

POLARIZATION TO WITHIN 3 PERCENT

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
3800. TO 5800. A	7.5 PERCENT	

38. FIELD OF VIEW	39. GROUND SWATH
3. DEG	30 NM DIAM CIRCLE FROM 600 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
3. DEG	30 NM FROM 600 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
0.5 DEG	2. DEG/SEC		POSIGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

POLARIMETER, SCANNING MECHANISM, CALIBRATORS, ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
45 LB	2.0 CU FT	20 WATTS	20 WATTS	50 WATTS	12 MON

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
SEE ITEM 31		

62. TELEMETRY REQUIREMENTS

187 BITS PER SECOND TOTAL

63. ADVANTAGES AND LIMITATIONS

AEROSOL CONTENT DATA WILL BE USEFUL IN INTERPRETATION OF IR RADIOMETRIC DATA; MOVING PARTS

64. REFERENCES

1) SEKERA, Z. AND HARIHARAN, T.: PROPOSAL FOR VISIBLE RADIATION POLARIZATION MEASUREMENTS FROM UNMANNED SPACECRAFT, UCLA,JAN 68.

65. HISTORICAL REMARKS

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
WIDE-BAND REAL-TIME DATA-TRANSMISSION EXPERIMENT	DATRAN	E29
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	9. TELEPHONE
KIESLING, J.	RCA ASTRO-ELECTRONICS	
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
BAUMUNK, J.	RCA ASTRO-ELECTRONICS	

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
NA	NA	NA	NA	INACT	PROPOSAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B. B.	NASA HDQTRS	OSSA/SRN	202-962-0891

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
RCA ASTRO-ELECTRONICS	PRINCETON, NEW JERSEY	NA	

26. INSTRUMENT TYPE	27. SECURITY
DATA RELAY, S-BAND SELF-FOCUSING PHASED-ARRAY TRANSPONDER	PRO

28. APPLICATION	29. SPACECRAFT
MET, ERSP	NIMBUS E

30. PURPOSE

PRIMARY-TO DEMONSTRATE THE IMPLEMENTATION OF WIDE-BAND AND NARROW-BAND DATA READOUT TO SMALL GROUND STATIONS.***SECONDARY-TO SOLVE VARIOUS OPERATIONAL PROBLEMS INCLUDING ACQUISITION AND TRACKING NETWORK DISCIPLINE REQUIRED IN MULTI-BEAM OPERATION, AND NEW ENERGY BALANCE PROCEDURES.

31. PRINCIPLES OF OPERATION

THE SATELLITE SYSTEM WILL CONSIST OF A SOLID-STATE SELF-FOCUSING, PHASE-CONJUGATED RETRODIRECTIVE ANTENNA WHICH WILL AUTOMATICALLY POINT ITS BEAM (OR BEAMS) IN THE DIRECTION OF A DISTANT GROUND STATION WHICH IS RADIATING A CONTINUOUS WAVE PILOT OF THE CORRECT FREQUENCY. DURING THE ALLOWABLE ON-PERIOD, THE ARRAY SENSES ANY GROUND-STATION PILOT TRANSMISSION AND FORMS A TRANSIT BEAM IN THE DIRECTION OF THE PILOT. THE BEAM TRACKS THE PILOT INDEPENDENT OF ANY SPACECRAFT MOTION. THE ARRAY ALSO HAS THE CAPABILITY OF BEAMING TO TWO OR MORE GROUND STATIONS. THE TRANSMITTER WOULD TURN OFF EITHER AT THE END OF THE COMMAND ON-PERIOD OR WHEN THE PILOT SIGNAL ENDS. ON THE GROUND, THE RECEIVED S-BAND (2200 MHZ WITH A 20 MHZ BANDWIDTH) SIGNAL IS DETECTED, DEMULTIPLEXED IF NECESSARY, AND FED TO SIGNAL PROCESSORS FOR DATA RECORDING OR PRINTOUT. THE GROUND STATION ANTENNA WOULD BE APPROXIMATELY 10 TO 15 FEET IN DIAMETER. OPERATION OF THIS GROUND STATION WITH THE SATELLITE PHASED ARRAY WILL DEMONSTRATE THE FEASIBILITY OF THE OVERALL SYSTEM, IDENTIFY NECESSARY OPERATIONAL PROCEDURES AND PROBLEMS, AND PROVIDE FIRM BASIS FOR THE DESIGN AND PRODUCTION OF LOW-COST PORTABLE OPERATIONAL TERMINALS.

32. PHENOMENA OBSERVED

WAVE PILOT FOR GROUND STATION ACQUISITION AND TRACKING

33. MEASUREMENT RANGE

34. PRECISION AND ACCURACY

SIGNAL TO NOISE RATIO = 40 DB AT LIMITING SLANT RANGE

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
2.200 GHZ		

38. FIELD OF VIEW	39. GROUND SWATH
NA	NA

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
NA	NA

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
NA	NA	MED	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS

TRANSPONDER, ANTENNA SYSTEM

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
SOURC/SEN				

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
	DELAYED TELEMETRY	ON COMMAND

62. TELEMETRY REQUIREMENTS

2200 MHZ TRANSPONDER WITH A 20 MHZ BANDWIDTH

63. ADVANTAGES AND LIMITATIONS

LOWER COST AND SMALLER S-BAND GROUND STATIONS BECOME FEASIBLE, ANTENNA HAS AUTOMATIC ELECTRONIC STEERING

64. REFERENCES

1) KIESLING, H.S. AND BAUMUNK, J.: PROPOSAL FOR WIDE-BAND REAL-TIME DATA TRANSMISSION, RCA ASTRO-ELECTRONICS, FEB 29, 68.

65. HISTORICAL REMARKS

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE				2. ACRONYM	3. EXP NO
WIND VELOCITY EXPERIMENT				AVCS	E18A
(TITLE CONT.)				4. RESUME DATE	5. VERSION
MODIFIED ADVANCED VIDICON CAMERA SYSTEM (AVCS)				11/10/69	0005
6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION			8. TELEPHONE	
WOODRICK, N.W.	IBM CORP FEDERAL SYS DIV			301-921-6000	
9. CO-INVESTIGATOR	10. ORGANIZATION			11. TELEPHONE	
LEESE, DR.J.A.	IBM CORP FEDERAL SYS DIV			301-921-6000	
12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
NA	NA	NA	NA	INACT	PROPOSAL
18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE		
SCHARDT, B.	NASA HDQTRS	OSSA/SRN	202-296-0891		
22. VENDOR	23. LOCATION		24. FLIGHT DATE	25. LEAD TIME	
			NA		

26. INSTRUMENT TYPE	27. SECURITY
IMAGER, 1-INCH MODIFIED AVCS TELEVISION	PRO

28. APPLICATION	29. SPACECRAFT
MET, ATM-PHYS	NIMBUS E

30. PURPOSE

PRIMARY-TO MEASURE THE HORIZONTAL AND VERTICAL DISTRIBUTION OF ATMOSPHERIC WIND VELOCITY FROM MEASUREMENTS OF CLOUD VELOCITIES AND CLOUD ALTITUDES.***SECONDARY-TO EVALUATE THIS DUAL TECHNIQUE AS A METHOD FOR OBTAINING QUANTITATIVE WIND VELOCITY INFORMATION ESPECIALLY OVER REGIONS FOR WHICH SUCH DATA IS SPARSE.

31. PRINCIPLES OF OPERATION

THIS EXPERIMENT COMPRISES TWO SENSORS,THE HIGH RESOLUTION ADVANCED VIDICON CAMERA SYSTEM(AVCS), DESCRIBED HERE, AND AN IR CLOUD-TOP TEMPERATURE RADIOMETER,DESCRIBED IN E18B. THE SENSORS ARE CONFIGURED SO THAT AT LEAST 2(AND AS MANY AS 10) COMPLETELY OVERLAPPING VIDICON IMAGES AND ONE IR SCAN OF THE SAME GEOGRAPHIC AREA WILL BE OBTAINED.THE EXPERIMENT WILL BE ACTIVATED ON THE FOUR ORBITS CORRESPONDING IN TIME TO THE FOUR STANDARD WORLD WEATHER WATCH RADIOSONDE OBSERVATION TIMES. IN THE DAYLIGHT PORTION OF THE SELECTED ORBIT,ONE TO THREE SCENES WILL BE OBSERVED AND A MINIMUM OF THREE PHOTOS OF EACH SCENE WILL BE OBTAINED. FROM A PAIR OF CLOUD PICTURES TAKEN OVER THE SAME GEOGRAPHICAL AREA AND A KNOWN NUMBER OF SECONDS APART, RELATIVE CLOUD MOTIONS WILL BE OBTAINED BY MEANS OF TWO-DIMENSIONAL CORRELATION OF THE TWO PICTURES.THE AVCS CONSISTS OF FOUR PRINCIPAL UNITS-THE OPTICAL SUBSYSTEM, VIDICON CAMERA TUBE, ELECTRONICS SUBSYSTEM, TAPE STORAGE FACILITY.THE OBJECTIVE LENS DIAMETER IS APPROXIMATELY ONE INCH WITH A FOCAL LENGTH OF 3.56 INCHES. A CONTROLLABLE IRIS WITH FIXED STOPS AT F/4,F/5,F/8, AND F/16 IS AVAILABLE. THE RESOLUTION IS 800 LINE PAIRS VERTICALLY AND 800/SINE WAVE CYCLES HORIZONTALLY. THE SIGNAL TO NOISE RATIO IS 32 DECIBELS.

32. PHENOMENA OBSERVED

VISIBLE RADIANT ENERGY FROM THE EARTH'S SURFACE AND ATMOSPHERE

33. MEASUREMENT RANGE

CLOUD VELOCITIES FROM 0 TO 200 MPH; DYNAMIC RANGE=16 GRAY LEVELS

34. PRECISION AND ACCURACY

WIND VELOCITY KNOWN TO WITHIN 5 TO 10 KNOTS

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.3 TO 0.7 MICRONS	NA	

38. FIELD OF VIEW	39. GROUND SWATH
12. BY 12. DEG	128 BY 128 NM FROM 600 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.02 DEG	0.25 NM FROM 600 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
0.003 DEG		MED	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

YAW ERRORS SHOULD BE KNOWN TO 0.05 DEGREE

47. COMPONENTS

AVCS/MIRROR,GYROS,TAPE RECORDER,COMMAND,MEMORY,ATTITUDE DATA SYS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
70 LB	2.8 CU FT	12 WATTS	6 WATTS		12 MON

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
	SENSITIVE			VIDICON TUBE

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
GRAY SCALE, POSITION	DELAYED AND REALTIME	3 SETS OF 3 PIC/OR

62. TELEMETRY REQUIREMENTS

60 KHZ BANDWIDTH RECORDER REQUIRED FOR VIDICON DATA. FRAME READ READ-OUT TIME IS 6 SECONDS. 1410 BITS OF HOUSEKEEPING DATA PER DATA FRAME.

63. ADVANTAGES AND LIMITATIONS

POSSIBLE APPLICATION TO OTHER EXPERIMENTS;SELECTION OF TRACKABLE CLOUD PATTERNS MAY BE DIFFICULT. CRITICAL POINTING ACCURACY

64. REFERENCES

1) WOODRICK, N.W.: PROPOSAL FOR A NIMBUS WIND VELOCITY EXPERIMENT, IBM CORP, BETHESDA, MD, FEB 68.***2) LEESE, J.: DIGITAL CROSS-CORRELATION TECHNIQUE FOR CLOUD VELOCITY DETERMINATION, IBM IRAD TASK, 1967.***3) WOODRICK, N.: THE DETERMINATION OF WIND VELOCITY FROM EARTH SATELLITE OBSERVATIONS OF CLOUD MOTIONS IBM IRAD TASK, AUG 64.

65. HISTORICAL REMARKS

AVCS AND CAR ARE BOTH PARTS OF THE WIND VELOCITY EXPERIMENT

66. DIAGRAMS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS

1. TITLE	2. ACRONYM	3. EXP NO
WIND VELOCITY EXPERIMENT	CAR	E18B
(TITLE CONT.)	4. RESUME DATE	5. VERSION
CLOUD ALTITUDE RADIOMETER	11/10/69	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
WOODRICK, N.W.	IBM CORP FEDERAL SYS DIV	301-921-6000
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
LEESE, DR.J.A.	IBM CORP FEDERAL SYS DIV	301-921-6000

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
NA	NA	NA	NA	INACT	PROPOSAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B.	NASA HDQTRS	OSSA/SRN	202-962-0891

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
		NA	

26. INSTRUMENT TYPE — 27. REQUIRED

RADIOMETER, INFRARED IMAGE-FORMING PASSIVE — PRO

28. APPLICATION	29. SPACECRAFT
MET, ATM-PHYS	NIMBUS E

30. PURPOSE

PRIMARY-TO MEASURE THE HORIZONTAL AND VERTICAL DISTRIBUTION OF ATMOSPHERIC WIND VELOCITY FROM MEASUREMENTS OF CLOUD VELOCITIES AND CLOUD ALTITUDES.***SECONDARY-TO EVALUATE THIS DUAL TECHNIQUE AS A METHOD FOR OBTAINING QUANTITATIVE WIND VELOCITY INFORMATION, ESPECIALLY OVER REGIONS FOR WHICH SUCH DATA IS SPARSE.

31. PRINCIPLES OF OPERATION

THIS EXPERIMENT COMPRISES TWO SENSORS,THE CLOUD ALTITUDE RADIOMETER (CAR), DESCRIBED HERE, AND THE ADVANCED VIDICON CAMERA SYSTEM(AVCS), DESCRIBED IN E18A. THE SENSORS ARE CONFIGURED SO THAT AT LEAST 2(AND AS MANY AS 10) COMPLETELY OVERLAPPING VIDICON IMAGES AND ONE IR SCAN OF THE SAME GEOGRAPHIC AREA WILL BE OBTAINED. THE EXPERIMENT WILL BE ACTIVATED ON THE FOUR ORBITS CORRESPONDING IN TIME TO THE FOUR STANDARD WORLD WEATHER WATCH RADIOSONDE OBSERVATION TIMES. IN THE DAYLIGHT PORTION OF THE SELECTED ORBIT, ONE TO THREE SCENES WILL BE OBSERVED AND A MINIMUM OF THREE PHOTOS OF EACH SCENE WILL BE OBTAINED.THE DETERMINATION OF CLOUD ALTITUDE WILL BE ACCOMPLISHED BY MEASURING CLOUD-EMITTED RADIATION WITHIN THE APPROPRIATE SPECTRAL INTERVAL USING AN IMAGE FORMING RADIOMETER. THE INSTRUMENT USES A LINEAR MULTI-ELEMENT SENSOR ARRAY ORIENTED PERPENDICULAR TO THE LINE OF FLIGHT. THE RADIOMETER USES THE FORWARD MOTION OF THE SPACECRAFT TO SCAN PARALLEL TO THE LINE OF FLIGHT. TO DETERMINE ABSOLUTE IR RADIATION LEVELS, CLOUD RADIANCE WILL BE COMPARED ONE OR MORE TIMES DURING EACH LINE SCAN WITH A REFERENCE SOURCE OF KNOWN LEVEL (A CHOPPER FLAG WHOSE EMISSIVITY AND TEMPERATURE ARE KNOWN).

32. PHENOMENA OBSERVED

INFRARED ENERGY IN THE 10 TO 11 MICRON REGION EMITTED BY CLOUDS

33. MEASUREMENT RANGE

TEMPERATURE FROM 190 TO 300 DEGREES KELVIN

34. PRECISION AND ACCURACY

CLOUD ALTITUDE WITHIN 2000 TO 3000 FT;TEMPERATURE WITHIN 1 K DEG

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
10. TO 11. MICRONS	NA	

38. FIELD OF VIEW	39. GROUND SWATH
12. BY 12. DEG	128 BY 128 NM FROM 600 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.05 DEG	0.5 NM FROM 600 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

YAW ERRORS SHOULD BE KNOWN TO 0.05 DEGREE

47. COMPONENTS

RADIOMETER

49. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
15 LB	0.6 CU FT				12 MON

54. INTERFERENCE	55. INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
CHOPPER ONCE/LINESCAN	DELAYED AND REALTIME	3 IMAGES/ORB W/TV

62. TELEMETRY REQUIREMENTS

4 ANALOG TELEMETRY SIGNALS REQUIRED DURING NOMINAL 32 SECOND RADIOMETER PICTURE SEQUENCE. TOTAL STORAGE REQUIREMENT FOR EACH SEQUENCE IS 1024 BITS.

63. ADVANTAGES AND LIMITATIONS

RADIOMETER COULD BE USED ON A TIME-SHARED BASIS WITH OTHER EXPERIMENTS

64. REFERENCES

1) WOODRICK, N.W.: PROPOSAL FOR A NIMBUS WIND VELOCITY EXPERIMENT, IBM CORP, BETHESDA, MD, FEB 68.***2) LEESE, J.: DIGITAL CROSS-CORRELATION TECHNIQUE FOR CLOUD VELOCITY DETERMINATION, IBM IRAD TASK, 1967.***3) WOODRICK, N.: THE DETERMINATION OF WIND VELOCITY FROM EARTH SATELLITE OBSERVATIONS OF CLOUD MOTIONS IBM IRAD TASK, AUG 68.

65. HISTORICAL REMARKS

AVCS AND CAR ARE BOTH PARTS OF THE WIND VELOCITY EXPERIMENT

66. DIAGRAMS

INDEXES

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P INDICATES A PROPOSAL

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—NATIONAL AERONAUTICS AND SPACE ACT OF 1958

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