X-733-72-464
PREPRINT

NASA TM X-66144
NTIS HC $18.50

DIGEST OF NASA EARTH OBSERVATION SENSORS

ROBERT R. DRUMMOND

DECEMBER 1972

GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND

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Material in this digest was compiled by IIT Research Institute under contract NAS5-21557

GODDARD SPACE FLIGHT CENTER
Greenbelt, Maryland

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Robert R. Drummond

ABSTRACT

A digest of technical characteristics of remote sensors and supporting technological experiments uniquely developed under NASA Applications Programs for Earth Observation Flight Missions is presented. Included are camera systems, sounders, interferometers, communications and experiments. In the text, these are grouped by types, such as television and photographic cameras, lasers and radars, radiometers, spectrometers, technology experiments, and transponder technology experiments. Coverage of the brief history of development extends from the first successful Earth Observation sensor aboard Explorer 7 in October, 1959, through the latest funded and flight-approved sensors under development as of October 1, 1972. A standard resume format is employed to normalize and mechanize the information presented.

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FOREWORD

The successful launching and operation of ERTS-1 represents the beginning of a new era in multispectral remote sensor applications for Earth observation. This major milestone in the NASA Space Applications Program marks the transition to a broad base of multi-discipline data applications programs. The intent of this text is to summarize the technical status of NASA remote sensor developments up to and including this transition point. The compilation of the instrument resumes required the cooperation and assistance of many individual investigators, project personnel, and program offices, and these efforts are greatly appreciated. The author wishes to acknowledge the continued support for this task by Mr. Jules Lehmann, Earth Observation Programs, Office of Applications, NASA Headquarters. Also the author wishes to thank the staff of IIT Research Institute for their efforts, particularly Norbert M. Katz, Sidney S. Verner, and Joseph E. Orth.

ACRONYMS AND DEFINITIONS

Spacecraft Acronyms

ATS	Applications Technology Satellite
ERTS	Earth Resources Technology Satellite
ESSA	Environmental Science and Services Administration (Predecessor to NOAA)
GEOS	Geodetic Earth Observatory Satellite
ITOS	Improved Tiros Operational Satellite
NOAA	National Oceanic and Atmospheric Administration
SMS	Synchronous Meteorological Satellite
Tiros	A name derived from Television Infrared Observation Satellite
TOS	Tiros Operational Satellite

Program Names

Apollo	Manned Lunar Program Series
Explorer	Scientific Satellite Program Series
Nimbus	Meteorological Research Satellite Program Series
Skylab	Manned Space Station Experiment
Tiros	Meteorological Satellite Program Series leading to Operational Meteorological Spacecraft

Earth Resources Survey Aircraft

C-130 A/C	Aircraft assigned to NASA as instrument carriers
NP3A A/C	Aircraft assigned to NASA as instrument carriers

Spacecraft Designations

Preflight and postflight designations for spacecraft are utilized in the text. The following NASA procedures apply to these designations:

1. Preflight: Spacecraft acronym or name followed by a letter (Example, ERTS-A) designates program sequence number for that individual spacecraft

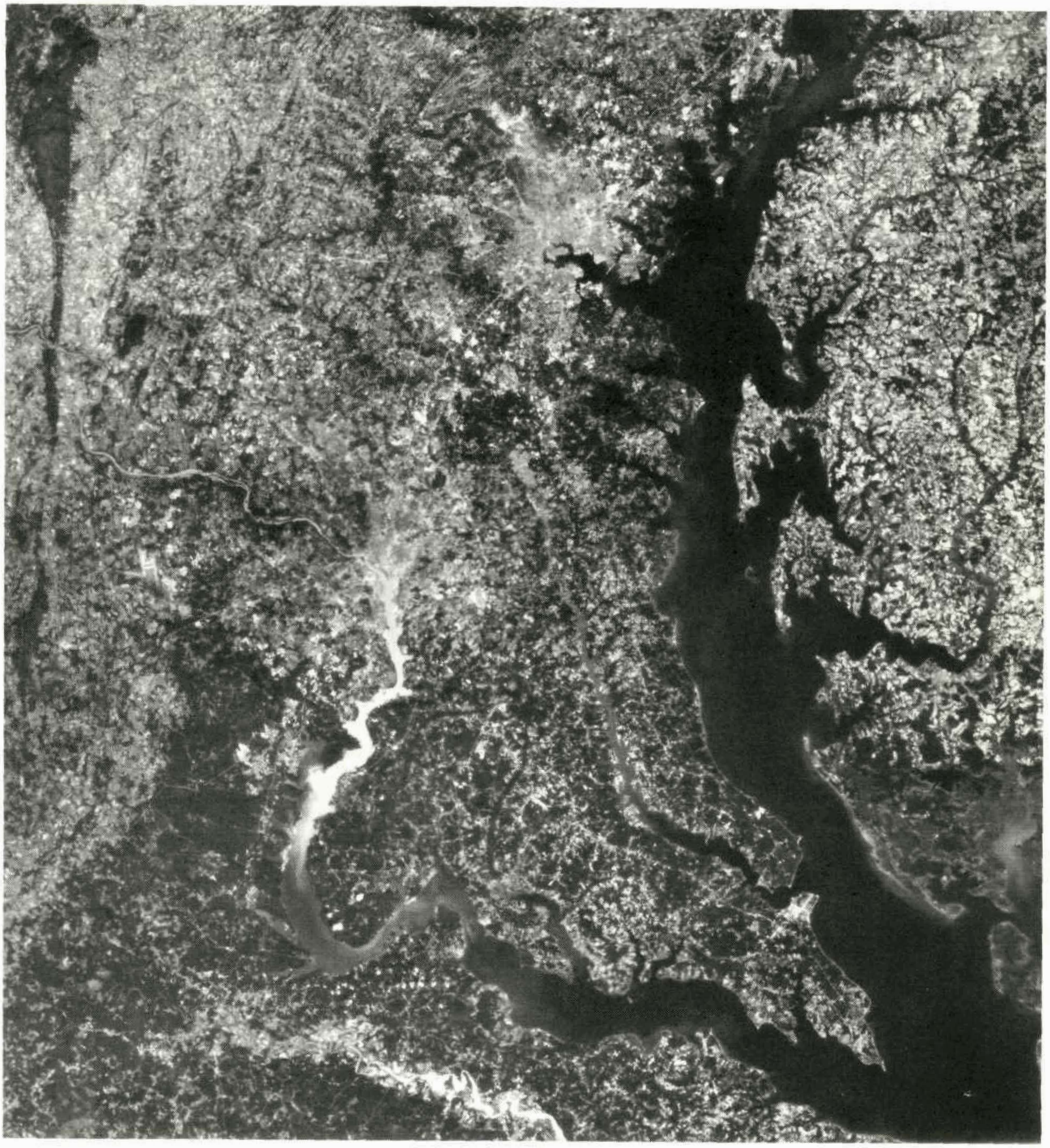
2. Postflight: Preflight program sequence letter is replaced by a flight sequence number (Example, ERTS-A became ERTS-1)

3. Where NASA produces and launches operational satellites for another agency the name changes from a NASA to an agency designation at the time

the operating spacecraft is delivered to the agency in orbit. (Example: ITOS-A became NOAA-1)

4. Program and flight sequence designations are independent and do not necessarily coincide. (Example ITOS-D became NOAA-2)

INDEX OF SENSORS



Frontispiece. An example of transmitted imagery from orbit, showing quality of detail attainable from ERTS-1 Multispectral Scanner. The scene is the Chesapeake Bay area including Washington, D.C. and Baltimore, Maryland. The image is from a single visible band (MSS Band 5) in the green extending from 0.5 to 0.6 microns, October 11, 1972, altitude 915 km (569 statute miles).

DIGEST OF NASA EARTH OBSERVATION SENSORS

INTRODUCTION

This report has been prepared as a digest of NASA Spaceborne Instrumentation, developed for Earth Observation Missions under the Space Applications Program. Historical coverage extends from the beginning of practical Earth Observation Space Missions, through the latest approved future flight experiment, as of October 1, 1972. The digest consists of a compilation of individual experiment resumes. A standard resume format was adopted to both normalize and mechanize the information presented.

All NASA sponsored experiments, representing significant steps in earth observation technology, were reviewed. The criteria of experiment selection for inclusion in the text are as follows:

1. Only custom designed spaceflight experiments were considered.

2. Only experiments contributing direct or indirect advances in earth observation sensor technology were included.

3. Past experiments were included that have successfully flown and have returned usable Earth Observation Data.

4. Future spaceflight experiments were included that were mission-approved and funded prior to October 1, 1972.

Some flight experiments were deleted by following the above criteria. These fall into two general categories.

1. Those experiments whose flights were unsuccessful and little or no significant data was returned from the effort.

2. Experiments utilizing "off-the-shelf" type hardware for Earth Observation, such as hand-held film cameras, etc.

Certain exceptions were taken to these criteria where remote sensor technological advances were significant.

1. The Day-Night Camera System (DNCS) was included (ref. page 42) even though the ATS-4 flight was unsuccessful, since the camera represented a significant effort in adapting the image orthicon TV tube to space applications.

2. Two custom-designed remote sensors, the Experimental 24-Channel Multispectral Scanner (ECMSS) (ref. page 106) and the Passive Microwave Imaging System (PMIS) (ref. page 178) are included, even though they were designed as Earth Observation Experiments aboard aircraft. Both are to be utilized in the Earth Resources Survey Aircraft Program. Each represents a significant milestone in Earth Observations sensor applications.

The task of collection of experiment information was initiated in 1968 by the NASA Electronics Research Center, Cambridge, Mass. under NASA Headquarters Task 160-44-02-28-25, Jules Lehmann, Program Manager. The ERC effort was under the technical direction of Raymond A. Minzer and John D. Oberholtzer. Contract NAS12-666 was awarded to IIT Research Institute to collect and develop experiment resumes and to develop an information storage and retrieval computer program for same. In the first quarter of 1970, prior to the liquidation of ERC, the project was transferred to the Goddard Space Flight Center, for continuation of the effort under the direction of Robert R. Drummond. Contract NAS 5-21557 was awarded IIT Research Institute to update and complete the resume effort. This contract was completed in October, 1972.

Under this effort, the resume format, as originally developed at ERC, was held constant. Attention was paid to completing the coverage of the resumes across the entire NASA Earth Observation Mission spectrum.

This text is thought to be the only up-to-date reference, summarizing custom-designed NASA Earth Observation Experiments in a single document. Only real instrumentation hardware aspects are represented. If an experiment had already flown before October 1, 1972, the resume should be representative of the actual flight configuration and not subject to further change. However, if an experiment was still under development for a future flight on this date, some changes could usually be expected as the experiment progresses through the development cycle from "approved proposal" to "flight-qualified hardware." In these cases, resume data should be checked with the principal investigator before use. In anticipation of this, a space for notes is left in the lower-right-hand corner of the resume for the convenience of the user.

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HISTORY OF EARTH OBSERVATION

The history of NASA Earth Observation Space Missions spans only a little over a decade. During this brief period, both Earth Observation objectives and custom designed sensor instrumentation have experienced exponential growth. The primary driving force behind these advances has been the NASA Meteorological Research Program. The practical beginning of the era started with the successful flight of Explorer 7 in October, 1959.

This scientific research spacecraft carried a uniquely designed sensor by Dr. V. E. Soumi, University of Wisconsin. Its title was, "Low Resolution Omnidirectional Radiometer" (LROR) (ref. page 150). The basic experimental objective was to map the "gross heat budget" of the Earth, and to determine how much solar energy is absorbed or reflected by the Earth and its atmosphere. This early spaceborne sensor has the distinction of being the first successful Earth Observation instrument to return usable data from space.

The first practical imagery from space, showing the Earth and its cloud cover, were obtained by two vidicon TV camera systems aboard the first satellite dedicated to meteorological research, TIROS I (April 1960). These cameras included features such as a shutter, slow TV readout of a long persistance image on the exposed vidicon tube, relatively low power and nominal bandwidth. Each camera had a different optical field of view, one narrow angle (VCSN) and the other wide angle (VCSW).

The flight of TIROS I was the first of a successful series of flights embodying similar spin-stabilized spacecraft and sensors. These pioneered global monitoring of cloud cover and soon proved valuable in detecting and tracking major weather phenomena such as frontal systems, hurricanes, etc.

New and revolutionary information is always followed by a slower learning period, before utility can be fully appreciated and future requirements defined. So it was with the early meteorological research program. Lags in new sensor applications were present in the TIROS program as knowledge was accumulated on operational capabilities of flight systems. This resulted in considerable repetition in spacecraft/sensor flights in a pseudo-operational mode, before advances in instrumentation were incorporated.

Offset approximately three years in a later time frame, the Nimbus Meteorological Research Satellite Program became the primary catalyst for remote sensor developments. The larger Nimbus payload capability and three-axis stabilized, Earth-oriented configuration, opened up new possibilities for sensor instrumentation.

Nimbus was initially conceived as an operational weather satellite. However, it was actually developed as the primary NASA meteorological research vehicle. As the follow-on research oriented effort, Nimbus spawned the bulk of remote sensor developments for Earth Observation in the middle period of the decade. The program still accounts for a major share of sensor experiments, although several Earth Observation Programs are active today.

The Application Technology Satellite Program (ATS), initiated in the middle 60's, stimulated imagery and technological support experiments from geosynchronous orbit. However, only the spin-stabilized spacecraft were successful. Launch and spacecraft failures plagued the series of gravity gradient-stabilized spacecraft and limited the realization of further geosynchronous earth observation development.

The middle period saw the TIROS configuration developed into the world's first operational weather satellites, the TOS series. These were designed, manufactured, and launched by NASA. They were funded and operated by the Environmental Science and Service Administration (ESSA), the predecessor to the National Oceanic and Atmospheric Administration (NOAA). The TOS/ESSA series utilized sensors that were adapted for operational use from sensors developed and proven in the Nimbus Meteorological Research Program. These spacecraft played a pioneering role in the development of operational earth observation procedures.

Exponential growth of Earth Observation requirements began to reach significant proportions in the latter quarter of the decade. Greater sophistication in measurement objectives and the growth of data applications were the dominate forces. Experiments aboard Nimbus III and IV created new vistas in observable information about atmospheric processes. Improvements under development for Nimbus E and F experiments, and the (despun-platform type) ITOS/NOAA second generation operational weather satellite program are pushing the state of the art in applications of remote sensors for low altitude global monitoring. These are being paralleled with continuous monitoring type geosynchronous orbit experiments under development for ATS-F and SMS-A.

In general, developments have gravitated toward multi-spectral imagers, radiometers, sounders, interferomenters, etc. for sampling, measuring and collecting atmospheric and surface information. These provide important inputs to analysis of global atmospheric circulation and weather distributions. The evolution of global weather analysis is still in its infancy, but showing signs of becoming an adolescent by the mid 70's. The current crop of developmental experiments, described herein, are expected to bring this about, as they reach the flight stage and generate new and improved data.

Possibly the most potent force for molding the future of remote sensing from orbit was begun in the latter quarter of the decade. This was the initiation of the Earth Resources Survey Program. This multisided Earth Observation program encompasses the Earth Resources Technology Satellite Research Program (ERTS), the Earth Resources Experiment Package (EREP) aboard Skylab A, and the Earth Resources Survey Aircraft Program.

Sensor requirements differ from those of the meteorology program by demanding spatial, spectral, and temporal data of generally higher resolution. Attention is also focused on the Earth's surface. The best compromises are required between identification of Earth details in multispectral bands, detector technology, imagery, radiometry, data rates, fields of view, stability, and periodic coverage. The state of the art in remote sensors is being pushed. ERTS-A, Skylab A, C-130 Aircraft, and NP3A Aircraft experiment payloads represent the exploratory first generation instruments in the Earth Resources Survey Program.

The anticipated utilization of data from these sensors is mushrooming at a fast rate. This was convincingly demonstrated in 1971 by the receipt of approximately 700 proposals for multidiscipline applications of ERTS-A/EREP data in response to a NASA request for data experiments. Ideal objectives require utilization of sensor output data to the theoretical limits of resolution. This implies systems and data processing precision never before attained from a space platform. Practical limitations are almost certain to govern the limits of initial utility for some users. However, one thing appears firm, the direction for instrumentation development is toward optimization to serve the widest user community. The future utilization of Earth Resources data has the potential for direct application in almost every phase of human endeavor. The sophistication of sensor developments is expected to be paced by major growth of the data user community. Each new application contributes to an expanding base of technical knowledge about the Earth. It also adds to the many benefits accruing from the overall space program. Piece by piece, the operating rules and constraints governing the global environment are being envolved through these efforts.

This brief history of sensor development has been presented to assist the reader in comprehending the significance of the decade covered by the resumes. As experiments grow in sophistication, so do the lead times for technical development and use. Elapsed time from concept to flight can be from three to five years. An additional three years can easily elapse between experimental and operational application. Operational applications tend to increase requirements for service life expectance. Past experience with sensors have been in the one-to-two year service life category. New requirements are pushing toward the 5-year goal. This means that possibly a number of the sensors summarized herein, will remain active for Earth Observation throughout the mid 1970's period.

TELEVISION AND PHOTOGRAPHIC CAMERAS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
ADVANCED VIDICON CAMERA SYSTEM	AVCS	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
ALBERT, J.	NESC/NOAA	202-655-4000
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/NOAA		202-655-4000

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

38. FIELD OF VIEW
89.0 BY 89.0 DEG

39. GROUND SWATH
1700 NM BY 1700 NM FROM 750 NM ALTITUDE

40. ANGULAR RESOLUTION
0.11 DEG

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

42. POINTING ACCURACY
0.5 DEG

43. POINTING RATE

44. ALTITUDE
MED CIRCULAR

45. INCLINATION
SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS
2 TV CAMERA SYSTEMS, 2 TAPE RECORDERS, SYSTEM ELECTRONICS

48. WEIGHT
43 LB

49. VOLUME

50. AVERAGE POWER
16 WATT

51. STANDBY POWER

52. PEAK POWER

53. MTBF

54. RF INTERFERENCE

55. MAGNETIC INTERFERENCE
SENSITIVE

56. NUCLEAR INTERFERENCE

57. THERMAL INTERFERENCE

58. SHIELDING
MAGNETIC SHIELDING USED

59. CALIBRATION
GRAY-SCALE CALIBRATION

60. DATA RECOVERY
DELAYED TELEMETRY

61. FREQUENCY OF OBSERVATION
DAYSIDE OF ORBIT

62. TELEMETRY REQUIREMENTS
RECORDER IS PLAYED BACK ON CDA STATION COMMAND VIA THE SPACE-CRAFT 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 MINIMIZ-ING 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.

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
ADVANCED VIDICON CAMERA SYSTEM	AVCS	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
ALBERT, J.	NESC/NOAA	202-655-4000

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/NOAA		202-655-4000

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.***SECOND-ARY-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 SPACE-CRAFT AND PERPENDICULAR TO THE SPIN AXIS. DURING PICTURE TAKING SEQUENCE THE CAMERA LOOKS AT THE NADIR. THE LENS IS A TEGEA KIN-OPTIC 108 DEGREE WIDE ANGLE LENS WITH A FOCAL LENGTH OF 5.7 MM AND AN ELECTROMAGNETICALLY CONTROLLED SHUTTER. THE CAMERA CON-VERTS THE OPTICAL IMAGE TO AN ELECTRICAL SIGNAL WHICH IS PRO-CESSED 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-INCRE-MENT 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 SPACE-CRAFT 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 MINIMIZ-ING 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.

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
ADVANCED VIDICON CAMERA SYSTEM	AVCS	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
ALBERT, J.	NESC/NOAA	202-655-4000
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/NOAA		202-655-4000

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, SCHEDULED FOR FLIGHT ON TOS H, WAS TEST FLOWN ON NIMBUS 1 AND 2, AND OPERATIONALLY ON ESSA 3,5,7 AND 9. 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 TEGA-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 DEVELOP 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 1,2; OPERATIONAL ON ESSA 3,5, AND 9.

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
ADVANCED VIDICON CAMERA SYSTEM	AVCS	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
ALBERT, J.	NESC/NOAA	202-655-4000

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/NOAA		202-655-4000

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, EFSP	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, SCHEDULED FOR FLIGHT ON TOS G AND E, WAS TEST FLOWN ON NIMBUS 1 AND 2 AND OPERATIONALLY ON ESSA 3 AND 5. ALL ARE SIMI-LAR 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 TEGA-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 PRO-CESSED 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-INCRE-MENT 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, MIMIMIZING 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 DEVELOP 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.

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
ADVANCED VIDICON CAMERA SYSTEM	AVCS	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0006

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
OBRIEN, J.(T.MON)	GODDARD SPACE FLT CENTER	301-982-5042
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
CPFF					INTEGRATION

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GARBACZ, M.L.	NASA HDQTRS	OA/ERO	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
RCA ASTRO-ELECTRONICS	PRINCETON, N.J.	1/70	NA

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

28. APPLICATION	29. SPACECRAFT
MET, ERSP	ITOS-1

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 MAG-NETICALLY DEFLECTED. IT HAS AN INHERENT STORAGE PROPERTY WHICH PERMITS A NOMINAL 6.5 SEC FRAME SCAN TIME. A GRAY-SCALE CALIBRA-TOR 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 PRO-CESSED 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	9.5 SEC

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	3.5 CU FT	9 WATTS		210 WATTS	1 YEAR

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
PROVIDE WIDE ANGLE VIEWING AT MODERATELY HIGH RESOLUTION

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.

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
ADVANCED VIDICON CAMERA SYSTEM	AVCS	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
BEBRIS, J.	GODDARD SPACE FLT CENTER	301-982-5042
9. CO-INVESTIGATOR	**10. ORGANIZATION**	**11. TELEPHONE**
BURDETT, G.L.	GODDARD SPACE FLT CENTER	301-982-5042

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
TEPPER, M.	NASA HDQTRS	OA/ERD	202-755-2322

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	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.

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
ADVANCED VIDICON CAMERA SYSTEM	AVCS	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
ARLAUSKAS, J.	GODDARD SPACE FLT CENTER	301-982-5042
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	OA/ERN	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
RCA ASTRO-ELECTRONICS	PRINCETON, N.J.	05/66	

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

28. APPLICATION	29. SPACECRAFT
MET	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 OPERA- TIONAL 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 DEPLOY- ED IN A FAN-LIKE ARRAY TO PRODUCE A 3-SEGMENT COMPOSITE PICTURE. EACH CAMERA COVERS A 37 DEG FOV WITH THE CENTER CAMERA POINT- ING STRAIGHT DOWN. THE OPTICAL AXIS OF THE OTHER 2 UNITS ARE RO- TATED 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 CAM- ERAS EMPLOY A 17 MM F/4 LENS WITH A SERVOCONTROLLED IRIS FOR EX- POSURE 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 PROGRAM- MED 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.

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
ADVANCED VIDICON CAMERA SYSTEM	AVCS	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0006

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
OBRIEN, J.(T.MON)	GODDARD SPACE FLT CENTER	301-982-5042

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
CPFF					OPERATIONAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GARBACZ, M.L.	NASA HDQTRS	OA/ERO	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
RCA ASTRO-ELECTRONICS	PRINCETON, N.J.	12/70	NA

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

28. APPLICATION	29. SPACECRAFT
MET, ERSP	NOAA-1

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 NOAA-1 IS BASICALLY SIMILAR TO THE SYSTEMS TEST FLOWN ON NIMBUS 1 AND 2 AND OPERATIONALLY FLOWN ON ESSA 3 AND 5. THE NOAA-1 SYSTEM CONSISTS OF 2 IDENTICAL 1-INCH 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	9.5 SEC

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	3.5 CU FT	9 WATTS		210 WATTS	1 YEAR

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

PROVIDE WIDE ANGLE VIEWING AT MODERATELY HIGH RESOLUTION

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 & 2, ESSA 3 & 5 AND ITOS-1

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
AUTOMATIC PICTURE-TRANSMISSION SYSTEM	APT	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
MOODY, J.C.	GODDARD SPACE FLT CENTER	301-982/5042

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/NOAA		202-655-4000

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. 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 4 AND 6.

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
AUTOMATIC PICTURE-TRANSMISSION SYSTEM	APT	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
SCHWALB, A.	NESC/NOAA	202-655-4000
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/NOAA		202-655-4000

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, J.: 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.

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
AUTOMATIC PICTURE-TRANSMISSION SYSTEM	APT	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
SCHWALB, A.	NESC/NOAA	202-655-4000
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/NOAA		202-655-4000

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.

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	AUTOMATIC PICTURE-TRANSMISSION SYSTEM
(TITLE CONT.)	
2. ACRONYM	APT
3. EXP NO	
4. RESUME DATE	09/01/72
5. VERSION	0005
6. PRINCIPAL INVESTIGATOR	SWCWALB, A.
7. ORGANIZATION	NESC/NOAA
8. TELEPHONE	202-655-4000
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	GLOVER, J.C.
19. AGENCY	NESC/NOAA
20. PGM OFFICE	
21. TELEPHONE	202-655-4000
22. VENDOR	RCA ASTRO-ELECTONICCS
23. LOCATION	PRINCETON, N.J.
24. FLIGHT DATE	12/68
25. LEAD TIME	
26. INSTRUMENT TYPE	IMAGER, 1-INCH AUTOMATIC-PICTURE-TRANSMISSION VIDICON
27. SECURITY	
28. APPLICATION	MET
29. SPACECRAFT	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 SCHEDULED FOR FLIGHT ON TOS H, 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, 6 AND 8. 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 RETORGRADE

46. SPECIAL REQUIREMENTS

2

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 1,2, AND ESSA 2,4,6;ALSO SCHED FOR TOS H

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
AUTOMATIC PICTURE-TRANSMISSION SYSTEM	APT	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0006

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
OBRIEN, J.(T.MON)	GODDARD SPACE FLT CENTER	301-982-5042

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
CPFF					INTEGRATION

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GARBACZ, M.L.	NASA HDQTRS	OA/ERO	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
RCA ASTRO-ELECTRONICS	PRINCETON, N.J	1/70	NA

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

28. APPLICATION	29. SPACECRAFT
MET	ITOS-1

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 MILLISEC, 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 MICRONS	NA	208. SECONDS

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	2.0 CU FT	7 WATTS		210 WATTS	1 YEAR

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

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

Field	Entry
1. TITLE	AUTOMATIC PICTURE-TRANSMISSION SYSTEM
(TITLE CONT.)	
2. ACRONYM	APT
3. EXP NO	
4. RESUME DATE	09/01/72
5. VERSION	0005
6. PRINCIPAL INVESTIGATOR	HUNTER, C.M.
7. ORGANIZATION	GODDARD SPACE FLT CENTER
8. TELEPHONE	301-982-5042
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	TEPPER, M.
19. AGENCY	NASA HDQTRS
20. PGM OFFICE	OA/ERD
21. TELEPHONE	202-755-2322
22. VENDOR	RCA ASTRO-ELECTRONICS
23. LOCATION	PRINCETON, N.J.
24. FLIGHT DATE	08/64
25. LEAD TIME	NA
26. INSTRUMENT TYPE	IMAGER, 1-INCH AUTOMATIC-PICTURE-TRANSMISSION VIDICON
27. SECURITY	UNC
28. APPLICATION	MET
29. SPACECRAFT	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 DI-ELECTRIC 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-KINOP-TIC, 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 PIC-TURE 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 BROAD-CASTS THE SIGNAL IN THE 136.95 MHZ BAND. AN APT GROUND STATION WITH AN APPROPRIATE ANTENNA, RECEIVER, AND A RECORDER CAN RE-CEIVE 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

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
AUTOMATIC PICTURE-TRANSMISSION SYSTEM	APT	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
MOODY, J.	GODDARD SPACE FLT CENTER	301-982-5042
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	OA/ERN	202-755-2322

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 PHOTO-CONDUCTOR. 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

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
AUTOMATIC PICTURE-TRANSMISSION SYSTEM	APT	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0006

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
OBRIEN, J.(T.MON)	GODDARD SPACE FLT CENTER	301-982-5042
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
CPFF					OPERATIONAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GARBACZ, M.L.	NASA HDQTRS	OA/ERO	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
RCA ASTRO-ELECTRONICS	PRINCETON, N.J.	12/70	NA

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

28. APPLICATION	29. SPACECRAFT
MET	NOAA 1

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; ESSA 2,4,6 AND ITOS 1 IN SIMILAR CONFIGURATION. THE 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 PER-PENDICULAR 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 RE-CEIVE 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 MICRONS	NA	208. SECONDS

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	2.0 CU FT	7 WATTS		210 WATTS	1 YEAR

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

SEE ITEM 31

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
AUTOMATIC PICTURE-TRANSMISSION SYSTEM	APT	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
STAMPFL, DR. R.A.	GODDARD SPACE FLT CENTER	301-982-5042

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
TEPPER, M.	NASA HDQTRS	OA/ERD	202-755-2322

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

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
DAY/NIGHT CAMERA SYSTEM	DNCS	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
MOODY, J.C.	GODDARD SPACE FLT CENTER	301-982-5042

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	OA/ECS	202-755-2322

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

26. INSTRUMENT TYPE	27. SECURITY
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
4.25 DEG	LIMB-TO-LIMB 1700 NM FROM GEO-SYNCH PLT

40. ANGULAR RESOLUTION	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	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
56 LB		21 WATTS		48 WATTS	

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

59. CALIBRATION	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

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
IMAGE-DISSECTOR CAMERA SYSTEM	IDCS	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
BRANCHFLOWER, G.A.	GODDARD SPACE FLT CENTER	301-982-5042
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. COMPLETION DATE	17. STATUS
				11/67	OPERATIONAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
BURKE, J.R.	NASA HDQTRS	OA/ECS	202-755-2322

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

26. INSTRUMENT TYPE	27. SECURITY
IMAGER, 1-INCH VISIBLE ELECTRICALLY-SCANNING PHOTOCATHODE	

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

E

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

38. FIELD OF VIEW	39. GROUND SWATH
14.6 BY 14.6 DEG	LIMB-TO LIMB(6040 NM) FROM GEO-SYNCH ALT

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.01 DEG	3.8 NM AT CENTER

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

46. SPECIAL REQUIREMENTS

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
20 LB	0.38 CU FT	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
	REALTIME TELEMETRY	EVERY 10 MINUTES

62. TELEMETRY REQUIREMENTS

LESS THAN 100 KHZ AT 100 RPM SATELLITE SPIN RATE.

63. ADVANTAGES AND LIMITATIONS

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

64. 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.

65. HISTORICAL REMARKS

SIMILAR TO NIMBUS D AND 3 IDCS.

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
IMAGE-DISSECTOR CAMERA SYSTEM	IDCS	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
BRANCHFLOWER, G.	GODDARD SPACE FLT CENTER	301-982-5042

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	OA/ERN	202-755-2322

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)OS-TROW, H. AND O. WEINSTEIN,: A REVIEW OF A DECADE OF SPACE CAMERA SYSTEMS DEVELOPMENT FOR METEOROLOGY, PRESENTED AT SOCIETY OF PHOTO-OPTICAL INSTRJMENTATION ENGINEERS, WASH. D.C., AUG 1968.

65. HISTORICAL REMARKS
REPLACES AVCS PLUS APT. FLOWN ON ATS 3. SCHEDULED FOR NIMBUS D.

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
IMAGE-DISSECTOR CAMERA SYSTEM	IDCS	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0007

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
BRANCHFLOWER, G.	GODDARD SPACE FLT CENTER	301-982-5042
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
	NAS 5-9619				OPERATIONAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B.B.	NASA HDQTRS	OA/ERN	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
ITT INDUSTRIAL LABS.	FORT WAYNE, INDIANA	04/70	NA

26. INSTRUMENT TYPE	27. SECURITY
IMAGER, 1-INCH ELECTRICALLY-SCANNING PHOTOCATHODE VISIBLE	UNC

28. APPLICATION	29. SPACECRAFT
MET	NIMBUS-4

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 MICRONS	NA	200. SECONDS

38. FIELD OF VIEW	39. GROUND SWATH
98.2 BY 73.6 DEG	1400 NM BY 900 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.

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
MULTISPECTRAL PHOTOGRAPHIC FACILITY: EARTH	MPF	S-190

(TITLE CONT.)	4. RESUME DATE	5. VERSION
RESOURCES EXPERIMENT PACKAGE (EREP)	09/01/72	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
DORNBACH, J. E.	MANNED SPACECRAFT CENTER	713-483-0123

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
					ENG.MODEL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
FISHCHETTI, T.L.	NASA HDQTRS	OA/ERS	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
ITEK CORPORATION		1973	

26. INSTRUMENT TYPE	27. SECURITY
CAMERA	UNC

28. APPLICATION	29. SPACECRAFT
ERSP	SKYLAB-A

30. PURPOSE

PRIMARY-TO OBTAIN PRECISION MULTISPECTRAL PHOTOGRAPHY WHICH WILL PROVIDE THE BASIS FOR A WIDE RANGE OF USER-ORIENTED STUDIES*** SECONDARY-TO EXTEND THE CAPABILITY FOR MULTISPECTRAL PHOTOGRAPHIC STUDY SIGNIFICANTLY BEYOND THAT REPRESNTED BY EXPERIMENT SO-65 (FOUR 70-MM CAMERAS APOLLO-9 EXPERIMENT).

31. PRINCIPLES OF OPERATION

THE FACILITY WILL UTILIZE SIX HIGH PRECISION 70MM CAMERAS WITH MATCHED DISTORTION AND FOCAL LENGTH. THE LENSES WILL HAVE A 6-INCH FOCAL LENGTH (21.2DEG FOV ACROSS FLATS) PROVIDING APPROXIMATELY 88NM SQUARE SURFACE COVERAGE FROM THE EXPECTED 235 NM ORBIT. THE SYSTEM WILL BE DESIGNED FOR THE FOLLOWING WAVELENGTH/FILM COMBINATION: .5-.6MM-PAN X B&W, .6-.7MM-PAN X B&W, .7-.8MM-IR B&W, .8-.9MM-IR B&W, .5-.88MM-IR COLOR, .4-.7MM-HI-RES COLOR. VARIOUS FILM/FILTER COMBINATIONS WILL BE STUDIED. THE SPECTRAL REGIONS DESIGNATED WERE SELECTED TO SEPERATE THE VISIBLE AND PHOTOGRAPHIC INFRARED SPECTRUM INTO THE BANDS THAT ARE EXPECTED TO BE MOST USEFUL FOR MULTISPECTRAL ANALYSIS. THE SELECTION WAS BASED ON EXPERIENCE GAINED IN THE PERFORMANCE OF EXPERIMENT S065. THE TWO COLOR FILMS WILL PROVIDE A PREREGISTERED CROSS-CHECK OF THE BLACK AND WHITE IMAGERY IN TWO PROVEN COLOR COMBINATIONS. PRIOR TO EACH PHOTO PASS, THE SKYLAB CREW WILL RECEIVE A GROUND UPDATE FOR EACH PHOTO SEQUENCE CONSISTING OF THE TIME FOR THE FIRST EXPOSURE, THE INTERVALOMETER SETTING, EXPOSURE SETTING, AND NUMBER OF EXPOSURES.

32. PHENOMENA OBSERVED

REFLECTED RADIATION FROM EARTH

33. MEASUREMENT RANGE

WAVELENGTHS 0.4 TO 0.9 MICRONS.

34. PRECISION AND ACCURACY

FILTER CALIBRATIONS, PRE AND POST FLIGHT.

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.4 TO 0.9 MICRONS	0.1 MICRONS	2.0 SEC

38. FIELD OF VIEW	39. GROUND SWATH
21.2 DEG	88 NM FROM 235 NM ORBIT.

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.004 DEG	100 FT FROM 235 NM ORBIT.

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
+-2 DEG		MED-CIRCULAR	50 DEG

46. SPECIAL REQUIREMENTS
MANUAL OPERATION

47. COMPONENTS
SEE ITEM 31

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
328 LB	18.9 CU FT			616 WATTS	

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
NONE	NONE	SENSITIVE	SENSITIVE	FILM STORED IN VAULT.

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
PRE-FLT CHECK-OUT	FILM RECOVERY	FLEXIBLE

62. TELEMETRY REQUIREMENTS
NA

63. ADVANTAGES AND LIMITATIONS
HIGH RESOLUTION MULTISPECTRAL PHOTOGRAPHY IN BANDS SIMILAR TO ERTS-A SENSORS.

64. REFERENCES
EXPERIMENT IMPLEMENTATION PLAN FOR MANNED SPACE FLIGHT EXPERIMENT, 11/24/69; TITLE: MULTISPECTRAL PHOTOGRAPHIC FACILITY (EARTH APPLICATIONS). EARTH RESOURCES REMOTE SENSING SYSTEMS, MSC-P6-0406

65. HISTORICAL REMARKS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
MULTISPECTRAL TERRAIN-PHOTOGRAPHY EXPERIMENT	MTP	S065
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
LOWMAN, DR. P.D.	GODDARD SPACE FLT CENTER	301-982-5042
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
COLWELL, DR. P.D.	UNIV OF CALIF. BERKLEY	415-845-6000

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
TERWILLIGER, R.G.	NASA HDQTRS	OA/ERO	202-755-2322

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

26. INSTRUMENT TYPE	27. SECURITY
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) INFRA-RED 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 ELEC-TRICALLY DRIVEN. THE CAMERAS ARE INSTALLED IN A COMMON MOUNT AND SYNCHRONIZED FOR SIMULTANEOUS EXPOSURE. THE MOUNT IS IN-STALLED IN THE COMMAND MODULE HATCH WINDOW DURING PHOTOGRAPHIC OPERATIONS AND THE SPACECRAFT WILL BE ORIENTED TO PROVIDE VERTI-CAL 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 RE-GION; 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

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.48 TO 0.9 MICRON		

38. FIELD OF VIEW	39. GROUND SWATH
52.0 BY 52.0 DEG	300 NM BY 300 NM FROM 300 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.009 DEG	280 FEET FROM 300 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
5.0 DEG		LOW CIRCULAR	MEDIUM POSIGRADE

46. SPECIAL REQUIREMENTS

ORBITAL POSITION DATA IS DESIRED AT THE TIME OF EACH EXPOSURE

47. COMPONENTS

4 HASSELBLAD CAMERAS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
28 LB	1.5 CU FT				

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
PRE- AND POSTFLIGHT ONLY	MANNED RETURN	AS PROGRAMMED

62. TELEMETRY REQUIREMENTS

NO SPECIFIC REQUIREMENTS

63. ADVANTAGES AND LIMITATIONS

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.

65. HISTORICAL REMARKS

SIMILAR CAMERAS FLOWN ON OTHER MANNED FLIGHTS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
RETURN BEAM VIDICON CAMERA	RBVC	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0007

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
WEINSTEIN, O.	GODDARD SPACE FLT CENTER	301-982-5042
9. CO-INVESTIGATOR	**10. ORGANIZATION**	**11. TELEPHONE**
RAGLAND, T.	GODDARD SPACE FLT CENTER	301-982-5042

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
CPIF	NAS5-11621		10/68	02/70	OPERATIONAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GEORGE, T.	NASA HDQTRS	OA/ER	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
RCA ASTRO-ELECTRONICS	PRINCETON, N.J.	7/72	NA

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

28. APPLICATION	29. SPACECRAFT
ERSP, MET	ERTS-1&B

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 NOMINAL RESOLUTION CAPABILITY OF THE SYSTEM IS 3200 TV LINES. EQUIPPED WITH A 126 MM F.L., T/3.2 LENS, EACH FRAME WILL COVER AN AREA OF 100 X 100 NM AT A RESOLUTION OF ABOUT 200 FEET PER TV LINE FROM 496 NM ALTITUDE. THE SENSOR IS CAPABLE OF RESOLVING ABOUT 60 LINE-PAIRS/MM AT A TOC OF 2:1

32. PHENOMENA OBSERVED

RADIATION FROM THE SURFACE OF THE EARTH IN THE VISIBLE SPECTRUM.

33. MEASUREMENT RANGE

DYNAMIC RANGE=9 GRAY LEVELS:BANDS 1&2, 7 GRAY LEVELS: BAND 3

34. PRECISION AND ACCURACY

S/N=33 DB AT 0.8 JOULE /SQ-CM: BANDS 1&2, 25 DB AT 1.2: BAND 3

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 496 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.002 DEG	200 FEET PER TV LINE FROM 500 NM ALTITUDE.

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED C IRCULAR	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
175 LB	3.0 CU FT	144 WATTS	76 WATTS	168 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
IN-FLIGHT CALIBRATION	DELAYED TELEMETRY	ON COMMAND

62. TELEMETRY REQUIREMENTS
20 MINUTES 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

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
SPIN-SCAN CLOUD-COVER CAMERA	SSCC	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
MONOCHROMATIC	09/01/72	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
	NAS5-9677			2/66	OPERATIONAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
BURKE, J.R.	NASA HDQTRS	OA/ECS	202-755-2322

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

26. INSTRUMENT TYPE	27. SECURITY
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 PRO-VIDES 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. RF 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

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
SPIN-SCAN CLOUD-COVER CAMERA	SSCC	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
MULTICOLOR	09/01/72	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	OA/ECS	202-755-2322

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

26. INSTRUMENT TYPE	27. SECURITY
IMAGER, THREE 1-INCH PHOTOMULTIPLIER VISIBLE-COLOR	

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 DIFFERNET 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	0.390 TO 0.700 MICRON
36. SPECTRAL RESOLUTION	
37. TIME CONSTANT	
38. FIELD OF VIEW	15.0 BY 15.0 DEG
39. GROUND SWATH	LIMB-TO-LIMB(10000 NM)FROM GEO-SYNCH ALT
40. ANGULAR RESOLUTION	0.006 DEG
41. SPATIAL RESOLUTION	2 NM AT CENTER
42. POINTING ACCURACY	NA
43. POINTING RATE	
44. ALTITUDE	SYNCH CIRCULAR
45. INCLINATION	EQUATORIAL POSIGRADE
46. SPECIAL REQUIREMENTS	
47. COMPONENTS	TELESCOPE,3 PHOTOMULTIPLIER LIGHT DETECTORS,STEP DRIVE MECHANISM
48. WEIGHT	23 LB
49. VOLUME	0.54 CU FT
50. AVERAGE POWER	10 WATTS
51. STANDBY POWER	
52. PEAK POWER	22 WATTS
53. MTBF	
54. RF INTERFERENCE	
55. MAGNETIC INTERFERENCE	
56. NUCLEAR INTERFERENCE	
57. THERMAL INTERFERENCE	
58. SHIELDING	
59. CALIBRATION	
60. DATA RECOVERY	REALTIME TELEMETRY
61. FREQUENCY OF OBSERVATION	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 MULTICOLOR SPIN-SCAN CAMERA (SSCC) ON ATS 1

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
VIDICON CAMERA SYSTEM	VCSM	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
MEDIUM-ANGLE LENS	09/01/72	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
RADOS, R.M. (MGR.)	GODDARD SPACE FLT CENTER	301-982-5042
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
TEPPER, M.	NASA HDQTRS	OA/ERD	202-755-2322

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.

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
VIDICON CAMERA SYSTEM	VCSM	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
MEDIUM-ANGLE LENS	09/01/72	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
RADOS, R.M. (MGR.)	GODDARD SPACE FLT CENTER	301-982-5042

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
TEPPER, M.	NASA HDQTRS	OA/ERD	202-755-2322

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.

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
VIDICON CAMERA SYSTEM	VCSM	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
MEDIUM-ANGLE LENS	09/01/72	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
RADOS, R.M. (MGR.)	GODDARD SPACE FLT CENTER	301-982-5042

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
TEPPER, M.	NASA HDQTRS	OA/ERD	202-755-2322

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 RE-LEASES 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.

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
VIDICON CAMERA SYSTEM	VCSN	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
NARROW-ANGLE LENS	09/01/72	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
STROUD, W.G. (MGR)	GODDARD SPACE FLT CENTER	301-982-5042

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
TEPPER, M.	NASA HDQTRS	OA/ERD	202-755-2322

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

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
VIDICON CAMERA SYSTEM	VCSN	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
NARROW-ANGLE LENS	09/01/72	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
STAMPFL, R.A. (MGR)	GODDARD SPACE FLT CENTER	301-982-5042
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
TEPPER, M.	NASA HDQTRS	OA/ERD	202-755-2322

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 STOR-AGE 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, F.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.

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
VIDICON CAMERA SYSTEM	VCSW	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
WIDE-ANGLE	09/01/72	0006

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
O'BRIEN, J.J.(T.MON)	GODDARD SPACE FLT CENTER	301-982-5042

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/NOAA		202-655-4000

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 TIROS MISSIONS. HOWEVER, THIS FLIGHT CARRIED 2, IN A CARTWHEEL CONFIGURATION (SIMILAR TO TIROS 9) THAT WERE MOUNTED ON THE SIDE OF THE SPACECRAFT AND CANTED 26 DEG TO EACH SIDE OF THE PLANE OF THE SATELLITES ROTATION. EACH CAMERA WAS 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

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
VIDICON CAMERA SYSTEM	VCSW	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
WIDE-ANGLE LENS	09/01/72	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
STROUD, W.G. (MGR)	GODDARD SPACE FLT CENTER	301-982-5042

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
TEPPER, M.	NASA HDQTRS	OA/ERD	202-755-2322

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-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

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	740 NM BY 740 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

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
VIDICON CAMERA SYSTEM	VCSW	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
WIDE-ANGLE LENS	09/01/72	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
STAMPFL, R.A. (MGR)	GODDARD SPACE FLT CENTER	301-982-5042

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
TEPPER, M.	NASA HDQTRS	OA/ERD	202-755-2322

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 RE-QUIRED 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.

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
VIDICON CAMERA SYSTEM	VCSW	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
WIDE-ANGLE LENS	09/01/72	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
RADOS, R.M. (MGR.)	GODDARD SPACE FLT CENTER	301-982-5042

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
TEPPER, M.	NASA HDQTRS	OA/ERD	202-755-2322

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
0.5 TO 0.65 MICRONS

36. SPECTRAL RESOLUTION
NA

37. TIME CONSTANT

38. FIELD OF VIEW
74.0 BY 74.0 DEG

39. GROUND SWATH
750 NM 750 NM FROM 475 NM ALTITUDE

40. ANGULAR RESOLUTION
0.2 DEG

41. SPATIAL RESOLUTION
1.5 NM PER TV-LINE FROM 475 NM ALTITUDE

42. POINTING ACCURACY

43. POINTING RATE

44. ALTITUDE
MED CIRCULAR

45. INCLINATION
MEDIUM POSIGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS
TV CAMERA, TRANSMITTER, TAPE RECORDER

48. WEIGHT
7 LB

49. VOLUME

50. AVERAGE POWER
9 WATTS

51. STANDBY POWER
NONE

52. PEAK POWER
9 WATTS

53. MTBF

54. RF INTERFERENCE

55. MAGNETIC INTERFERENCE
SENSITIVE

56. NUCLEAR INTERFERENCE

57. THERMAL INTERFERENCE

58. SHIELDING
MAGNETIC SHIELDING USED

59. CALIBRATION
NO IN-FLIGHT CALIBRATION

60. DATA RECOVERY
DELAYED AND REALTIME

61. FREQUENCY OF OBSERVATION
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

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
VIDICON CAMERA SYSTEM	VCSW	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
WIDE-ANGLE LENS	09/01/72	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
RADOS, R.M. (MGR.)	GODDARD SPACE FLT CENTER	301-982-5042

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
TEPPER, M.	NASA HDQTRS	OA/ERD	202-755-2322

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 RE-QUIRED FOR THE TARGET IMAGE TO BE ELECTRICALLY ERASED.THE CAMERA IS ALIGNED PARALLEL TO THE SATELLITE'S SPIN AXIS AND IS AUTO-MATICALLY 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.

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

118

1. TITLE	2. ACRONYM	3. EXP NO
VIDICON CAMERA SYSTEM	VCSW	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
WIDE-ANGLE LENS	09/01/72	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
RADOS, R.M. (MGR.)	GODDARD SPACE FLT CENTER	301-982-5042
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
TEPPER, M.	NASA HDQTRS	OA/ERD	202-755-2322

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 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.

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
VIDICON CAMERA SYSTEM	VCSW	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
WIDE-ANGLE LENS	09/01/72	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
RADOS, R.M. (MGR.)	GODDARD SPACE FLT CENTER	301-982-5042
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
TEPPER, M.	NASA HDQTRS	OA/ERD	202-755-2322

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.

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
VIDICON CAMERA SYSTEM	VCSW	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
WIDE-ANGLE LENS	09/01/72	0C05

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
RADOS, R.M. (MGR.)	GODDARD SPACE FLT CENTER	301-982-5042

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
TEPPER, M.	NASA HDQTRS	OA/ERD	202-755-2322

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 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 MAG-NETIC 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 PRO-CESSED FOR STORAGE IN 2 SECS. A MINIMUM INTERVAL OF 10 SEC BE-TWEEN PICTURES IS REQUIRED FOR THE TARGET IMAGE TO BE ELECTRI-CALLY ERASED. THE CAMERA IS ALIGNED PARALLEL TO THE SATELLITES SPIN AXIS AND IS AUTOMATICALLY TRIGGERED SO AS TO BE IN A PIC-TURE TAKING MODE ONLY WHEN DIRECTED TOWARD THE EARTH. TRANSMIS-SION OF THE ENTIRE REEL OF 32 PICTURES CAN BE ACCOMPLISHED IN 100 SEC BY A 2-WATT FM TRANSMITTER OPERATING AT A NOMINAL FRE-QUENCY 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.

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
VIDICON CAMERA SYSTEM	VCSW	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
WIDE-ANGLE LENS	09/01/72	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
RADOS, R.M. (MGR.)	GODDARD SPACE FLT CENTER	301-982-5042

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
TEPPER, M.	NASA HDQTRS	OA/ERD	202-755-2322

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.

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
VIDICON CAMERA SYSTEM	VCSW	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
WIDE-ANGLE LENS	09/01/72	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
RADOS, R.M. (MGR.)	GODDARD SPACE FLT CENTER	301-982-5042

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	OA/ERO	202-755-2322

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 TRIG- GERED 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 VIDI- CON 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 ACCOM- PLISHED 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.

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
VIDICON CAMERA SYSTEM	VCSW	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
WIDE-ANGLE LENS	09/01/72	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
RADOS, R.M. (MGR.)	GODDARD SPACE FLT CENTER	301-982-5042
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	04/ERO	202-755-2322

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 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.

LASERS AND RADARS

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
LASER DETECTOR	LDEC	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
PLOTKIN, DR. H.H.	GODDARD SPACE FLT CENTER	301-982-5042

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	OA/ECD	202-755-2322

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 PHOTCMULTIPILER TUBE WITH A 1 IN (2.54 CM) DIAMETER BI-ALKALI PHOTOCATHODE (EMR TYPE 541D-C1-14). 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.

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
LASER REFLECTOR	LRFF	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
PLOTKIN, DR. H.H.	GODDARD SPACE FLT CENTER	301-982-5042

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	OA/ECD	202-755-2322

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

26. INSTRUMENT TYPE	27. SECURITY
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 TELE-SCOPE AND THEN A DIGITAL COUNTER MEASURES THE ROUND-TRIP TRAVEL TIME OF THE LIGHT PULSES. THIS GIVES THE DISTANCE TO THE SATEL-LITE 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:68-2<, 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.

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
LASER RETROREFLECTOR	LREF	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0001

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
PLOTKIN, H.H.	GODDARD SPACE FLT CENTER	301-982-5042
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
MINOTT, P.O.	GODDARD SPACE FLT CENTER	301-982-5042

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

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
DILLER, D.S.	NASA HDQTRS	OA/ES	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
APL ASSEMBLING RFLCTR			

26. INSTRUMENT TYPE	27. SECURITY
REFLECTOR, 270 CUBE CORNER REFLECTORS - 35 MM ACROSS FLATS	UNC

28. APPLICATION	29. SPACECRAFT
GEOD	GEOS-C

30. PURPOSE

PRIMARY - SUPPORT INVESTIGATIONS SUCH AS POLAR MOTION, FAULT MOTION, EARTH ROTATION RATE, EARTH TIDES, AND CONTINENTAL DRIFT THEORY.*** SECONDARY - CONTRIBUTE TO CALIBRATION, DATA ACCURACY DETERMINATION, AND INPROVEMENT OF CANDIDATE TRACKING SYSTEMS.

31. PRINCIPLES OF OPERATION

WHEN THE SATELLITE IS WITHIN RANGE AND 15 OR MORE DEGREES ABOVE THE HORIZON THE REFLECTOR ARRAY REFLECTS BACK TO THE SOURCH LASER TRACKING SYSTEMS. THE LASER ARRAY GEOMETRY SHAL6 BE DESIGNED AND ATTITUDE PASSIVELY CONTROLLED SUCH THAT DURING /HE USEFUL ORBIT LIFETIME (10-20 YEARS) THE MAXIMUM ERROR IN THE FIRST REFLECTION POINT OF THE ARRAY RELATIVE TO THE CENTER OF GRAVITY OF THE S/C DOES NOT CAUSE MORE THAN A 5 CM ERROR IN THE RANGE MEASUREMENT ASSUMING AN INFINITELY NARROW PULSE. THE LASER ARRAY IS TO BE CONFIGURED ON THE LATERAL SURFACE OF A CONIC FRUSTRUM WITH THE LATERAL SURFACE ADJOINING THE BOTTOM SURFACE AT A 45 DEGREE ANGLE.

32. PHENOMENA OBSERVED

33. MEASUREMENT RANGE

34. PRECISION AND ACCURACY

RANGE MEASUREMENT GOAL IS 10 CM.

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

38. FIELD OF VIEW	39. GROUND SWATH
FROM 15 DEG ABOVE HOR.	

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		927 KM(MEAN	115 DEGREE S

46. SPECIAL REQUIREMENTS

47. COMPONENTS
MIN 270 CUBE CORNER REFLECTORS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
15-18 LB	NONE INTERNAL	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 NONE		AS SCHEDULED

62. TELEMETRY REQUIREMENTS
NONE

63. ADVANTAGES AND LIMITATIONS

64. REFERENCES
GEOS-C SPACECRAFT EXPERIMENT REQUIREMENTS DOCUMENT, REV 1, 12 MAY 1972.

65. HISTORICAL REMARKS
IMPROVED VERSION OF GEOS 2 LASER REFLECTOR

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
RADAR ALTIMETER	RALT	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0001

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
STANLEY, H.R.	NASA WALLOPS STATION	703-824-3411

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

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
DILLER, D.S.	NASA HDQTRS	OA/ES	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
		6/74	

26. INSTRUMENT TYPE	27. SECURITY
RADAR ALTIMETER	UNC

28. APPLICATION	29. SPACECRAFT
GEOD	GEOS C

30. PURPOSE

PRIMARY - DEMONSTRATE FEASIBILITY AND UTILITY TO MAP TOPOGRAPHY GLOBAL SEA SURFACE. *** SECONDARY - DEVELOP TECHNOLOGY LEADING TO ULTIMATE SYSTEM WITH 10 CM CAPABILITY.

31. PRINCIPLES OF OPERATION

WITH SUITABLE ALTIMETRY AND SUFFICIENT ACCURACY IN DETERMINATION OF THE GEOCENTRIC POSITION OF THE SPACECRAFT THE GEOMETRY OF THE OCEAN SURFACE CAN BE DESCRIBED AND MEAN SEA LEVEL DETERMINATIONS MADE. COMMAND TRANSMISSIONS IN THE STADAN REGION OF 148.2 TO 154.2 MHZ FOR MODE SELECTION AND LOW-NOISE RECEIVER IN/OUT. TELEMETRY IN THE 136 TO 137 MHZ RANGE FOR MODE AND MEASUREMENT INFORMATION AND HOUSEKEEPING. GLOBAL MODE MAX DAILY SCHEDULE OF 8-30 MIN OPERATIONS, EACH SEPERATED BY ONE HOUR, AND SHORT PULSE MODE MAX DAILY SCHEDULE OF 3-30 MIN OPERATIONS EACH SEPERATED BY ONE HOUR.

32. PHENOMENA OBSERVED

TIME-VARYING OCEAN SURFACE AND QUASI-STEADY STATE DEPARTURES.

33. MEASUREMENT RANGE

34. PRECISION AND ACCURACY

ABSOLUTE, PLUS/MINUS 5 METER: RELATIVE, PLUS/MINUS 1 METER.

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
13.9 GHZ		

38. FIELD OF VIEW	39. GROUND SWATH

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
2		927 KM(MEAN)	115 DEGREES

46. SPECIAL REQUIREMENTS

TEMP LIMITS (ELECTRONICS) MINUS 10 TO PLUS 40 DEG C.

47. COMPONENTS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
85	0.4			100	

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

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
		11-30 MIN OBS/DAY

62. TELEMETRY REQUIREMENTS

SEE ITEM 31

63. ADVANTAGES AND LIMITATIONS

64. REFERENCES

GEOS-C SPACECRAFT EXPERIMENT REQUIREMENTS DOCUMENT, REV 1, 12 MAY 1972.

65. HISTORICAL REMARKS

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
SATELLITE RADIO BEACON EXPERIMENT	SRBE	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0002

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
DAVIES, K.	ESSA-BOULDER, COL.	303-447-1000

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

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
BURKE, J.R.	NASA HDQTRS	OA/ECS	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME

26. INSTRUMENT TYPE	27. SECURITY
BEACON, TRANSMITTER AND RECEIVER	UNC

28. APPLICATION	29. SPACECRAFT
IONOSPHERES AND RADIO PHYSICS	ATS-F/G

30. PURPOSE

PRIMARY-TO STUDY IONOSPHERIC AND EXOSPHERIC PROCESSES THROUGH RADIO TRANSMISSIONS SUITABLE FOR FARADAY ROTATION AND DIFFERENTIAL GROUP DELAY MEASUREMENTS ***SECONDARY-MAKE COHERENT PHASE SCINTILLATION MEASUREMENTS AND PROVIDE A SOURCE FOR ACCURATE MEASUREMENTS OF IONOSPHERIC ABSORPTION AT A SINGLE FREQUENCY.

31. PRINCIPLES OF OPERATION

RADIO-BEACON TECHNIQUES EXPLOIT THE DISPERSION OF RADIO SIGNALS IN THE PROPOGATION MEDIUM. THERE ARE TWO BASIC APPROACHES. IN THE PRESENCE OF A LONGITUDINAL MAGNETIC FIELD, THE DISPERSION BETWEEN THE MAGNETO-IONIC COMPONENTS OF A LINEARLY-POLARIZED SIGNAL CAUSE THE PLANE OF POLARIZATION TO ROTATE PROGRESSIVELY AS THE WAVE PROPAGATES. THIS IS THE FARADAY EFFECT, BY WHICH IT IS POSSIBLE TO DETERMINE THE ELECTRON CONTENT (THE NUMBER OF ELECTRONS IN A COLUMN OF UNIT CROSS SECTION) ALONG THE PROPOGATION PATH. THE SECOND APPROACH COMPARES THE DISPERSION ON TWO DISTINCT FREQUENCIES. FOR INSTANCE, IF TWO PHASE-RELATED SIGNALS ARE TRANSMITTED, A MEASUREMENT OF THE RELATIVE CHANGE OF PHASE BETWEEN THE TWO SIGNALS RECEIVED AT A DISTANT POINT GIVES THE ELECTRON CONTENT ALONG THE PROPOGATION PATH. THIS IS THE PHASE-PATH METHOD, OFTEN CALLED DIFFERENTIAL DOPPLER, AND IT IS INDEPENDENT OF THE AMBIENT MAGNETIC FIELD. THE ESSENCE OF THE BEACON TECHNIQUE FOR EXOSPHERIC STUDIES IS TO MEASURE THE IONOSPHERIC ELECTRON CONTENT BY THE FARADAY METHOD, AND TO SUBTRACT ONE FROM THE OTHER TO ARRIVE AT THE ELECTRON CONTENT OF THE EXOSPHERE.

32. PHENOMENA OBSERVED

PHASE DIFFERENCE&POLARIZATION ROTATION OF VHF&UHF RADIO SIGNALS

33. MEASUREMENT RANGE

NA

34. PRECISION AND ACCURACY

0.05 CYCLE IN A 1 MHZ DIFFERENCE SIGNAL

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

46. SPECIAL REQUIREMENTS

47. COMPONENTS

TRANSMITTER, ANTENNA, ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
5 LB		15 WATTS			

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

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

62. TELEMETRY REQUIREMENTS

ALL FREQUENCIES DERIVED FROM A 1 MHZ SOURCE. FOR FARADAY MEASUREMENTS: 200 HZ BANDWITH REQUIRED.

63. ADVANTAGES AND LIMITATIONS

64. REFERENCES

1) GRUBB, R. N., ATS-F BEACON TRANSMITTER AND RECEIVING SYSTEMS ENGINEERING CONSIDERATIONS

65. HISTORICAL REMARKS

RADIOMETERS

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INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
EXPERIMENTAL 24-CHANNEL MULTISPECTRAL SCANNER	ECMSS	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	03/04/71	0002

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
KORB,C.C.	MANNED SPACECRAFT CENTER	713-483-3111
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
			10/68	06/71	FINAL TESTS

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
CLEMENCE, R.	MSC		

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
BENDIX CORPORATION	ANN ARBOR, MICHIGAN		

26. INSTRUMENT TYPE	27. SECURITY
RADIOMETER (SCANNING)	UNC

28. APPLICATION	29. SPACECRAFT
ERSP	C-130 A/C

30. PURPOSE

PRIMARY-TO ACQUIRE AND RECORD MULTISPECTRAL SCANNING DATA OF THE EARTH'S TERRAIN IN SEPERATE SPECTRAL BANDS IN A TIME-AND-SPACE-COINCIDENT MANNER***SECONDARY-TO ESTABLISH THE VARIOUS SPECTRAL BANDS THAT PROVIDE USEFUL INFORMATION IN THE GEOLOGY, HYDROLOGY, OCEANOGRAPHY, AND AGRICULTURAL DISCIPLINES.

31. PRINCIPLES OF OPERATION

THE RADIOMETER USES AN ALL REFLECTIVE SYSTEM. A 45-DEG MIRROR SCANS CROSS-TRACK WHILE THE A/C FORWARD MOTION GIVES THE SECOND DIMENSION. THE MIRROR RATE IS SELECTED TO GIVE CONTIGUOUS LINES ACROSS THE TERRAIN. THE SPECTRAL BANDS ARE FORMED BY DETECTOR ARRAYS IN THE FOCAL PLANE OF TWO GRATING SPECTROMETERS. THE DETECTORS INCLUDE P/M TUBES, SI AND GE PHOTODIODES, IN-SB PHOTOVOLTAIC CELLS AT 77 DEG.K, AND HG DOPED GE AT 25 DEG.K. DURING INACTIVE PART OF SCAN,THE TOTAL OPTICAL SYSTEM VIEWS FIELD FILLING CALIBRATION SOURCES TO CALIBRATE OUT CHANGES IN OPTICAL TRANSMISSION CHARACTERISTICS. TWO THERMOELECTRICALLY CONTROLLED BLACK BODIES ARE USED FOR THE THERMAL AND REFLECTIVE BANDS. ONE CALIBRATION SOURCE IS EITHER A UV/VIS./NEAR-IR OR "SKYLIGHT" REFERENCE.THE SIGNAL FROM A DETECTOR IS AMPLIFIED,THEN PROCESSED INTO AN 8-BIT WORD. A MEMORY BUFFER UNIT REMOVES DEAD TIME IN THE SCAN CYCLE TO GIVE A UNIFORM BIT RATE OUTPUT. TWO CHANNELS ARE MULTIPLEXED AND PLACED ON ONE TRACK OF A 24-TRACK RECORDER. THE 13TH CHANNEL HAS HOUSEKEEPING DATA. THE 24TH HAS THE TIME CODE. THE DATA ANALYSIS GROUND STATION GENERATES (A) SCREENING VIA A 3 COLOR TV DISPLAY, (B) IMAGERY OF 3 SEPERATE BANDS IN B/W OR FALSE COLOR, (C) COMPUTER COMPATIBLE TAPES.

32. PHENOMENA OBSERVED

REFLECTED AND THERMAL RADIATION FROM THE EARTH'S SURFACE

33. MEASUREMENT RANGE

VISIBLE AND INFRARED REGIONS.

34. PRECISION AND ACCURACY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.34 TO 13 MICRONS	24 CHANNELS	

38. FIELD OF VIEW	39. GROUND SWATH
NA	80 DEG SCAN ANGLE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.1146DEG	

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
NA		1.5K TO 30K FT	

46. SPECIAL REQUIREMENTS

47. COMPONENTS

OPTICS, DETECTORS, GRATING, 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

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
INTERNALLY (SEE ITEM 31)	FROM RETURNED TAPES	CONTINUOUS

62. TELEMETRY REQUIREMENTS

NA

63. ADVANTAGES AND LIMITATIONS

DATA CAN BE PROCESSED IN LARGE-SCALE DIGITAL COMPUTERS.

64. REFERENCES

ZAITZEFF, E. M, ET. AL., MSDS: AN EXPERIMENTAL 24-CHANNEL MULTISPECTRAL SCANNER SYSTEM, BENDIX TECHNICAL JOURNAL, SUMMER/ AUTUMN 1970.

65. HISTORICAL REMARKS

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
EARTH RADIATION BUDGET	ERB	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0002

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
SMITH, W. L.	NAT. OC. & ATM. AGENCY	

9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
DRUMMOND, A. J.	EPPLEY LABORATORIES, INC	

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

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B.B.	NASA HDQTRS	OA/ERN	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
		1974	

26. INSTRUMENT TYPE	27. SECURITY
RADIOMETER	UNC

28. APPLICATION	29. SPACECRAFT
MET, SOLAR PHYSICS	NIMBUS-F

30. PURPOSE

PRIMARY-TO ASCERTAIN EARTH RADIATION BUDGET BY 1) MEASURING INCOMING SOLAR RADIATION BETWEEN 0.2 TO >40 MICRONS, 2) MEASURING. OUTGOING EARTH REFLECTED AND EMITTED RADIATION IN THE SAME SPECTRAL BANDS.

31. PRINCIPLES OF OPERATION

EMITTED AND REFLECTED RADIATION FROM EARTH IS MEASURED IN TWO WAYS: 1) AN INTEGRATION OVER THE ENTIRE EARTH'S DISC MEASURING TOTAL TERRESTRIAL FLUX PASSING THROUGH A UNIT AREA AT SATELLITE ALTITUDE; 2) A SERIES OF MEASUREMENTS OF THE RADIANCE EMITTED AND REFLECTED FROM RELATIVELY SMALL AREAS AT A NUMBER OF ZENITH AND AZIMUTH ANGLES. ANGULAR DISTRIBUTION OF RADIANCE IS DETERMINED BY A SCAN SYSTEM PROVIDING OBSERVATIONS OF LOCAL ZENITH AND AZIMUTH ANGLES. THE INSTRUMENT INCLUDES A SCANNING RADIOMETER HEAD WHICH CONTAINS 4 SHORTWAVE AND 4 LONGWAVE CHANNELS WITH 0.25 DEG FOV IN THE SCAN PLANE AND 5 DEG IN THE NORMAL PLANE. SCANNING TAKES PLACE FROM THE NADIR TOWARD THE HORIZON. COVERAGE IN 5 DEG GAPS IS OBTAINED BY ROTATION OF THE HEAD ABOUT A VERTICAL AXIS. IN THIS MANNER COVERAGE EXTENDS 20 DEG TO EACH SIDE OF THE NOMINAL SCAN PLANE. FIVE SCAN MODES ARE AVAILABLE UPON COMMAND FROM THE GROUND. SCANS TAKING PLACE AT 22.5, 90 DEG, ETC. FROM THE ORBITAL PLANE ARE ACCOMPLISED BY PERFORMING ADDITIONAL ROTATIONS OF THE HEAD ABOUT THE VERTICAL AXIS PRIOR TO SCAN. THE FIFTH MODE IS A COMPOSITE OF THE FIRST TWO MODES. A COMPLETE SCAN CYCLE IN EACH OF THE FOUR BASIC MODES IS 112 SEC PERMITTING UP TO 9 DIFFERENT VIEWS OF AN INDIVIDUAL AREA.

32. PHENOMENA OBSERVED

INCOMING AND REFLECTED SOLAR RADIATION, TERRESTRIAL RADIATION

33. MEASUREMENT RANGE

UV, VISIBLE, IR TO GREATER THAN 40 MICRONS

34. PRECISION AND ACCURACY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.2 TO >40. MICRONS		112 SECONDS

38. FIELD OF VIEW	39. GROUND SWATH

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.25 DEG	

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

46. SPECIAL REQUIREMENTS

47. COMPONENTS
RADIOMETER, OPTICS, ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
56 LB	2.5 CU FT	30 WATTS			

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

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

62. TELEMETRY REQUIREMENTS

63. ADVANTAGES AND LIMITATIONS

64. REFERENCES
PRELIMINARY DATA SHEET FOR NIMBUS-F, NOV., 1970.

65. HISTORICAL REMARKS

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
ELECTRICALLY-SCANNING MICROWAVE RADIOMETER	ESMR	E12

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0009

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
NORDBERG, DR. W.	GODDARD SPACE FLT CENTER	301-982-5042
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
			01/69		ENG.MODEL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B.B.	NASA HDQTRS	OA/ERN	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
SPACE GENERAL CORP	EL MONTE, CALIFORNIA	12/72	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 TEMPERATURE WITHIN 1.0 DEG K; ABSOLUTE TEMP.WITHIN 2.0 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 1.28 DEG	1400 NM BY 13 NM FROM 600 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
1.28 DEG	13 NM FROM 600 NM ORBIT

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED	SUN-SYNCH HIGH NOON

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	4.5 CU FT	42 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
ANTENNA SIDELOBE SUPRESSION 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

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
ELECTRONICALLY SCANNING MICROWAVE RADIOMETER	ESMR-F	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0002

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
NORDBERG, W.	GODDARD SPACE FLIGHT CEN	301-982-5042

9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
CONAWAY, A. W.	GODDARD SPACE FLIGHT CEN	301-982-5042

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

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B.B.	NASA HDQTRS	OA/ERN	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
		1974	

26. INSTRUMENT TYPE	27. SECURITY
RADIOMETER, MICROWAVE	UNC

28. APPLICATION	29. SPACECRAFT
MET, ERSP	NIMBUS-F

30. PURPOSE

PRIMARY-TO MEASURE LIQUID WATER CONTENT OF CLOUDS***SECONDARY-TO MEASURE DISTRIBUTION AND VARIATION OF SEA-ICE COVER***TERTIARY-TO MEASURE GROSS CHARACTERISTICS OF LAND-SURFACES(VEGETATION, SOIL MOISTURE, AND SNOW COVER).

31. PRINCIPLES OF OPERATION

THE INSTRUMENT IS A DICKE TYPE RADIOMETER CONSISTING OF A SINGLE TIME-SHARED RECEIVER AND AN ELECTRICALLY SCANNING PHASED ARRAY ANTENNA OPERATING AT 0.8-CM. THE ANTENNA BEAM IS SCANNED THROUGH +OR-35 DEG THROUGH 98 DISCRETE BEAM POSITIONS. THE ANGULAR RESOLUTION WILL BE APPROXIMATELY 0.75 DEG AT THE 3 DB POINTS AT BROADSIDE SETTING. THE BEAM TILT ANGLE IS 40 DEG FROM THE ARRAY NORMAL. THE BRIGHTNESS TEMPERATURE MEASURED BY THIS INSTRUMENT DEPENDS PRIMARILY UPON THE LIQUID WATER CONTENT OF CLOUDS WHEN MEASURED AT LOW-AND MID-LATITUDES. AT POLAR LATI-TUDES, THE MEASURED BRIGHTNESS TEMPERATURE IS PRIMARILY RELATED TO THE OCCURRENCE OF SEA ICE AND SNOW COVER ON THE ICE. OVER LAND, THE MEASURED BRIGHTNESS TEMPERATURES WILL DEPEND LARGELY ON THE COMPOSITION, ROUGHNESS, AND TEMPERATURE OF THE SURFACE. MEASUREMENTS AT BOTH POLARIZATIONS WILL PERMIT THE DELINEATION OF THESE PARAMETERS, ESPECIALLY BETWEEN SURFACE ROUGHNESS AND MOISTURE. THE ABSOLUTE VALUE OF THE RADIATION TEMPERATURE OF THE ANTENNA WILL BE MEASURED TO AN ACCURACY OF 2 DEG K. CALI-BRATION WILL BE ACHIEVED BY THE USE OF THREE REFERENCE SOURCES, 180, 300, AND 338 DEG K.

32. PHENOMENA OBSERVED

MICROWAVE EMISSION FROM EARTH AND CLOUDS

33. MEASUREMENT RANGE

37 GHZ IN VERTICAL AND HORIZONTAL POLARIZATION

34. PRECISION AND ACCURACY

SEE ITEM 31

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

38. FIELD OF VIEW	39. GROUND SWATH
0.75 DEG	8 NM BY 840 NM FROM 600 NM ORBIT

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.75 DEG	8 NM

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

46. SPECIAL REQUIREMENTS

47. COMPONENTS
ANTENNA RECEIVER, ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
80 LB	5.1 CU FT	65 WATTS			

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

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
ON BOARD		CONTINUOUS

62. TELEMETRY REQUIREMENTS

63. ADVANTAGES AND LIMITATIONS

64. REFERENCES
PRELIMINARY DATA SHEET FOR NIMBUS-F, OCT., 1970

65. HISTORICAL REMARKS

C

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
EREP MULTISPECTRAL SCANNER	EMSS	S-192

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
KORB, C. L.	MANNED SPACECRAFT CENTER	713-483-0123
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
					ENG.MODEL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
FISCHETTI, T.L.	NASA HDQTRS	OA/ERS	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
HONEYWELL RADIATION CEN.		1973	

26. INSTRUMENT TYPE	27. SECURITY
CONICAL SCANNING RADIOMETER	UNC

28. APPLICATION	29. SPACECRAFT
ERSP	SKYLAB-A

30. PURPOSE

TO GATHER HIGH RESOLUTION LINE SCAN IMAGERY OF SELECTED EARTH RESOURCES GROUND CALIBRATION SITES IN SIMULTANEOUS SPECTRAL BANDS COMPARABLE TO ERTS A & ERAP DATA. OBJECTIVE IS FEASIBILITY EVALUATION OF SPECTRUM MATCHING DATA PROCESSING TECHNIQUES FOR IDENTIFICATION OF EARTH RESOURCES FEATURES.

31. PRINCIPLES OF OPERATION

THE INSTRUMENT CONSISTS OF AN OPTICAL-MECHANICAL SCANNER, A SPECTRAL DISPERSION SYSTEM, A GROUP OF THREE IN-FLIGHT CALIBRATION SOURCES, AND AN ARRAY OF DETECTORS (SI, GE, HG-CD-TE). THE OUTPUT OF THE DETECTORS IS AMPLIFIED, DIGITIZED, REFORMATTED AND RECORDED ON TAPE. A FOLDED 12-INCH REFLECTING TELESCOPE IS THE COLLECTOR. THE USE OF THIS LARGE COLLECTOR WILL PROVIDE THE NECESSARY DIFFRACTION-LIMITED RESOLUTION FOR THE THERMAL IR CHANNEL (10.2-12.5 MICRONS) AS WELL AS PROVIDING THE NECESSARY ENERGY THROUGHOUT TO ACHIEVE MODERATE S/N RATIOS IN A HIGH RESOLUTION SYSTEM. THE RADIANT ENERGY COLLECTED BY THE SCAN MIRROR IS CONSTRAINED TO PASS THROUGH TWO NEARLY ADJACENT ENTRANCE SLITS WHICH ARE SIZED FOR EQUIVALENT ANGULAR FOV'S. THE SLITS ACT AS BOTH THE FIELD STOP OF THE TELESCOPE AND THE ENTRANCE SLIT FOR THE PRISM SPECTROMETER. SINCE THE RADIANT ENERGY PASSES THROUGH THE FIELD STOPS PRIOR TO SPECTRAL SEPARATION, EACH DETECTOR ON A GIVEN SCAN LINE OBSERVES THE SAME SPATIAL ELEMENT ON THE GROUND, BUT IN A DIFFERENT SPECTRAL REGION. THE THIRTEEN SPECTRAL BANDS ARE 0.41-0.46, 0.46-0.51, 0.52-0.556 AND 0.565-0.609, 0.62-0.67, 0.68-0.762, 0.783-0.88, 0.98-1.08, 1.09-1.19, 1.20-1.30, 1.55-1.75, 2.10-2.35 AND 10.2-12.5 MICRONS

32. PHENOMENA OBSERVED

REFLECTED AND THERMAL RADIATION FROM THE EARTH'S SURFACE

33. MEASUREMENT RANGE

VISIBLE, NEAR IR, AND THERMAL WAVELENGTHS

34. PRECISION AND ACCURACY

ABOUT 1% IN VISIBLE & REFLECTIVE IR, 0.4 DEG K IN THERMAL IR

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.41 TO 12.5 MICRONS	SEE ITEM 31	

38. FIELD OF VIEW	39. GROUND SWATH
0.02 BY 10. DEG	40 NM FROM ORBIT

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.005 DEG	130 FT VISIBLE, 260 FT IR FROM ORBIT

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		235 NM	50 DEG

46. SPECIAL REQUIREMENTS

CRYO-COOLER & DETECTORS REPLACEABLE BY OPERATOR.

47. COMPONENTS

OPTICAL-MECHANICAL SCANNER, PRISM SPECTROMETER, DICHROIC FILTER

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
300 LB	19.3 CU FT	180 WATTS	90 WATTS	266 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
SELF CONTAINED 100/SEC.	MANUAL TAPE RETURN	FLEXIBLE

62. TELEMETRY REQUIREMENTS

ONBOARD RECORD 22 DATA CHANNELS, 8-BIT ACCURACY.
1.0 MBITS/SEC/TRACK.

63. ADVANTAGES AND LIMITATIONS

PERMITS COMPARISONS OF SPECTRAL IMAGERY IN COMPATIBLE FORMAT WITH ERTS-A, EREP, & GROUND SITE INFORMATION.

64. REFERENCES

EXPERIMENT IMPLEMENTATION PLAN FOR MANNED SPACE FLIGHT EXPERIMENTS, TITLE: TEN-BAND MULTISPECTRAL SCANNER NO. S-192.
SKYLAB A, EREP USERS HANDBOOK, NASA MSC, FEB. 1971.

65. HISTORICAL REMARKS

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
FLAT-PLATE RADIOMETER	FPR	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0009

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	OA/ERO	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
UNIVERSITY OF WISCONSIN	MADISON,WISCONSIN	1/70	NA

26. INSTRUMENT TYPE	27. SECURITY
RADIOMETER, FOUR IR/VISIBLE LOW RESOLUTION THERMISTORS.	UNC

28. APPLICATION	29. SPACECRAFT
MET	ITOS-1

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, AND C. 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

NEAR UV VISIBLE, NEAR IR, THERMAL IR.

34. PRECISION AND ACCURACY

5K DEGREES IN THERMAL IR.

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

38. FIELD OF VIEW	39. GROUND SWATH
180. DEG	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
7	0.75				1 YEAR

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

INSTRUMENT IS BROAD RANGE, LOW ACCURACY TYPE.

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.

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
FLAT-PLATE RADIOMETER	FPR	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0008

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
CPFF					OPERATIONAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GARBACZ, M.L.	NASA HDQTRS	OA/ERO	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
UNIVERSITY OF WISCONSIN	MADISON, WISCONSIN	12/70	NA

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

28. APPLICATION	29. SPACECRAFT
MET	NOAA-1

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 B AND C AND HAS FLOWN ON ITOS-1. 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

EARTH ALBEDO-ENERGY RADIATED TO SPACE BY EARTH

33. MEASUREMENT RANGE

NEAR UV, VISIBLE, NEAR IR, THERMAL IR

34. PRECISION AND ACCURACY

5 K DEG IN THERMAL IR

35. SPECTRAL RANGE
0.3 TO 30.0 MICRONS

36. SPECTRAL RESOLUTION

37. TIME CONSTANT
CONTINUOUS

38. FIELD OF VIEW
180 DEG

39. GROUND SWATH
LIMB-TO-LIMB

40. ANGULAR RESOLUTION
NA

41. SPATIAL RESOLUTION

42. POINTING ACCURACY

43. POINTING RATE

44. ALTITUDE
MED CIRCULAR

45. INCLINATION
SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS
NONE

47. COMPONENTS
4 SENSORS (THERMISTORS), ELECTRONICS

48. WEIGHT
7 LB

49. VOLUME
0.75 CU FT

50. AVERAGE POWER

51. STANDBY POWER

52. PEAK POWER

53. MTBF
1 YEAR

54. RF INTERFERENCE

55. MAGNETIC INTERFERENCE

56. NUCLEAR INTERFERENCE
SENSITIVE

57. THERMAL INTERFERENCE
SENSITIVE

58. SHIELDING
FPR THERMALLY ISOLATED

59. CALIBRATION
VIEW OF HOUSING

60. DATA RECOVERY
DELAYED TELEMETRY

61. FREQUENCY OF OBSERVATION
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
INSTRUMENT IS BROAD RANGE, LOW ACCURACY TYPE.

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 3,5,7,9 AND ITOS-1

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
HIGH-RESOLUTION INFRARED RADIOMETER	HRIR	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0005

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
TEPPER, M.	NASA HDQTRS	OA/ERD	202-755-2322

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	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

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
HIGH-RESOLUTION INFRARED RADIOMETER	HRIR	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	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
HALEY, DR. R.	NASA HDQTRS	OA/ERN	202-755-2322

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	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

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
HIGH-RESOLUTION INFRARED RADIOMETER	HRIR	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
CHERRIX, G.T.	GODDARD SPACE FLT CENTER	301-982-5042
9. CO-INVESTIGATOR	**10. ORGANIZATION**	**11. TELEPHONE**
ALLISON, L.J.	GODDARD SPACE FLT CENTER	301-982-5042

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	OA/ERN	202-755-2322

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	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.

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
HIGH RESOLUTION INFRARED RADIATION SOUNDER	HRIRS	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0002

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
MCCULLOCH, A. W.	GODDARD SPACE FLT CENTER	301-982-5042
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
SMITH, W. L.	NOAA	

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

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B.B.	NASA HDQTRS	OA/ERN	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
		1974	

26. INSTRUMENT TYPE	27. SECURITY
RADIOMETER, IR	UNC

28. APPLICATION	29. SPACECRAFT
MET	NIMBUS-F

30. PURPOSE

PRIMARY-TO OBTAIN SIMULTANEOUS GLOBAL INFRARED RADIANCES IN THE 4.3 MICRON AND 15 MICRON CO2 BANDS TO DETERMINE THE THERMAL STRUCTURE OF THE ATMOSPHERE FROM THE GROUND TO 40 KM WITH THE HIGHEST ATMOSPHERIC TEMPERATURE RESOLUTION ACHIEVABLE WITH IR MEASUREMENTS.

31. PRINCIPLES OF OPERATION

THE INSTRUMENT IS A FILTER WHEEL DEVICE WITH TWO WAVELENGTH RANGES SCANNING NORMAL TO THE ORBIT PLANE WITH A SCAN ANGLE OF +OR-35 DEG ABOUT THE NADIR. THE SHORT WAVELENGTH DETECTOR VIEWS THE 3.7 TO 4.6 MICRON RADIATION IN SIX INTERVALS. SIMULTANEOUSLY, THE LONG WAVELENGTH DETECTOR VIEWS FROM 6.3 TO 15 MICRONS IN TEN STEPS. AVERAGE CLEAR-COLUMN RADIANCES FOR EACH CHANNEL WILL BE DERIVED FROM A 10X10 MATRIX OF SPATIALLY INDEPENDENT FOV'S. THE CLEAR COLUMN RADIANCE IS COMPUTED DIRECTLY FROM THE OBSERVED RADIANCES USING SURFACE TEMPERATURES AND EFFECTIVE OBSCURATION AMOUNT (THE RATIOS OF THE FRACTIONAL CLOUD COVERS OF ADJACENT FOV'S) ESTIMATED FROM 3.8 AND 11 MICRON WINDOW OBSERVATIONS. THE CLEAR-COLUMN RADIANCES IN THE 4.3 AND 15 MICRON CO2 CHANNELS WILL BE USED TO CALCULATE THE TEMPERATURE PROFILE FROM THE 40 KM LEVEL DOWN TO THE EARTH'S SURFACE. THE WATER VAPOR PROFILE OF THE TROPOSPHERE WILL BE DEDUCED FROM THE 6.3 MICRON WATER VAPOR ABSORPTION BAND MEASUREMENTS. THE SPATIAL RESOLUTION (15 NM) AND CONTIGUOUS GEOMETRIC SAMPLING WILL ALLOW CLEAR CLOUD INTERSTICES TO BE RESOLVED AND CONSEQUENTLY THE CLEAR AIR RADIANCE CONTRIBUTION TO BE EXTRACTED FROM THE OBSERVED RADIANCES EVEN UNDER PARTIAL CLOUDY CONDITIONS.

32. PHENOMENA OBSERVED

IR RADIANCES FROM THE ATMOSPHERE

33. MEASUREMENT RANGE

THERMAL IR REGION

34. PRECISION AND ACCURACY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
3.8 TO 15 MICRONS		

38. FIELD OF VIEW	39. GROUND SWATH
1.5 BY 1.5 DEG	16 NM BY 840 NM FROM 600 NM

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
1.5 DEG	16NM BY 16NM FROM ORBIT

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

46. SPECIAL REQUIREMENTS

47. COMPONENTS
OPTICS, DECTECTOR, CRYOSTAT, ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
45 LB	1.4 CU FT	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
	TELEMETRY	CONTINUOUS

62. TELEMETRY REQUIREMENTS

63. ADVANTAGES AND LIMITATIONS

64. REFERENCES
PRELIMINARY DATA SHEET FOR NIMBUS-F, NOV., 1970.

65. HISTORICAL REMARKS

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
INFRARED TEMPERATURE-PROFILE RADIOMETER	ITPR	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0009

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
SMITH, W.L.	NOAA	301-899-1220
9. CO-INVESTIGATOR	**10. ORGANIZATION**	**11. TELEPHONE**
WARK, D.Q.	NOAA	301-899-1220

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

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B.B.	NASA HDQTRS	OA/ERN	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
GULTON INDUSTRIES	ALBUQUERQUE, N.MEXICO	12/72	40 MONTHS

26. INSTRUMENT TYPE	27. 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 DE-RIVING THREE-DIMENSIONAL TEMPERATURE OF THE ATMOSPHERE FOR OPERATIONAL FORECASTS BY THE MID 1970'S.

31. PRINCIPLES OF OPERATION

INSTRUMENT IS SOMEWHAT SIMILAR TO THE NIMBUS-2 MRIR. ITPR WILL MEASURE IR RADIATION IN FOUR SPECTRAL INTERVALS OF THE 15-MICRON CARBON DIOXIDE BAND, A SPECTRAL INTERVAL OF THE ROTATIONAL WATER VAPOR BAND,AND IN THE 3.8 AND 11-MICRON SPECTRAL WINDOWS. COVER-AGE IS CLUSTER-SAMPLED IN THREE CLUSTERS OF 10 BY 14 INSTANTAN-EOUS FOV'S PER CLUSTER DISTRIBUTED SYMMETRICALLY ABOUT EITHER SIDE OF NADIR BUT STAGGERED BY CLUSTER IN THE ORBITAL DIRECTION. EACH CLUSTER MATRIX CONTAINS 140 RESOLUTION ELEMENTS. MEASURE-MENTS IN THE CARBON DIOXIDE AND WATER VAPOR ABSORPTION BANDS WILL BE USE TO CALCULATE THE TEMPERATURE PROFILES AND THE TOTAL WATER VAPOR IN THE LOWER STRATOSPHERE AND TROPOSHERE BY INVERT-ING THE RADIATIVE TRANSFER EQUATION USING NUMERICAL AND MATH-EMATICAL TECHNIQUES. THE STATISTICAL FLUCTUATIONS OF THE RAD-IATION DATA FROM THE INDEPENDENT RESOLUTION ELEMENTS WILL BE UTILIZED IN THE SOLUTION TO ACCOUNT FOR THE ATTENUATION OF THE CLOUDS IN ADDITION TO THE TWO WINDOW MEASUREMENTS WHICH SHOULD ENABLE CLOUD CONTAMINATION OF THE RADIANCES TO BE DETECTED AND ELIMINATED, THUS PERMITTING ACTUAL DETERMINATION OF TEMPERATURE PROFILES DOWN TO THE EARTH'S SURFACE.

32. PHENOMENA OBSERVED

IR ENERGY EMITTED FROM THE SURFACE AND ATMOSPHERE OF THE EARTH

33. MEASUREMENT RANGE

0-200 ERGS/SEC/SQ-CM/STERADIAN/CM**-1

34. PRECISION AND ACCURACY

BETTER THAN 0.25 ERG/SEC/SQ-CM/STERADIAN/CM**-1

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
3.8 TO 11. MICRONS		0.4 SEC

38. FIELD OF VIEW	39. GROUND SWATH
1.5 BY 1.5 DEG	15 NM BY 15 NM FROM 600 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
1.5 DEG	15 NM FROM 600 NM ALTITUDE

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		MED	SUN-SYNCH HIGH NOON

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. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
			SENSITIVE	THERM. STBLZD TO 25+-5C

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
BLACK BODY;SPACE VIEW	DELAYED TELEMETRY	CONTINUOUS

62. TELEMETRY REQUIREMENTS
IR DATA - SEVEN 10-BIT WORDS 2.5 TIMES PER SECOND

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.

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
L-BAND RADIOMETER: EARTH RESOURCES EXPERIMENT	LBR	S-194

(TITLE CONT.)	4. RESUME DATE	5. VERSION
PACKAGE (EREP)	09/01/72	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
EVANS, D.	MANNED SPACECRAFT CENTER	713-483-0123
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
					ENG.MODEL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
FISCHETTI, T.L.	NASA HDQTRS	OA/ERS	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
AIRBOURNE INST. LABS.		1973	

26. INSTRUMENT TYPE	27. SECURITY
MICROWAVE RADIOMETER	UNC

28. APPLICATION	29. SPACECRAFT
ERSP	SKYLAB-A

30. PURPOSE

PRIMARY-TO MEASURE BRIGHTNESS TEMPERATURE OF THE TERRESTRIAL SURFACE IN ORDER TO COMPILE A COMPREHENSIVE SURFACE BRIGHTNESS TEMPERATURE MAP***SECONDARY-TO DETERMINE THE DIELECTRIC CONSTANT AND THE RATIO OF ELECTRICAL-TO-THERMAL EFFECTIVE DEPTH ALONG THE EARTH'S SURFACE BY COMPARING RADIOMETER DATA WITH SIMULTANEOUS MEASUREMENTS MADE AT VARIOUS GROUND LOCATIONS.

31. PRINCIPLES OF OPERATION

THE RADIOMETER IS A LOW-NOISE SWITCHED RADIOMETER UTILIZING GAIN MODULATION TECHNIQUES. A SIGNAL PROCESSOR DETECTS, AMPLIFIER, AND SYNCHRONOUSLY DEMODULATES THE SIGNAL AND PROVIDES A DIGITAL OUTPUT CORRESPONDING TO A 0-350 DEG K INPUT TEMPERATURE RANGE. THE ANTENNA IS A 40-IN SQUARE ARRAY CONSISTING OF 64 FOLDED DI-POLE ELEMENTS. RADIATION EMITTED BY A BODY, DIRECTLY PROPORT-IONAL TO TEMPERATURE IS RECEIVED BY THE ANTENNA- ENERGY IS THEN COUPLED FROM THE ANTENNA TO A CALIBRATION NETWORK PASSING THROUGH A DIODE SWITCH WHICH IS SWITCHING PEIODICALLY BETWEEN THE ANTENNA AND A THERMALLY CONTROLLED REFERENCE LOAD. BY CHANG-ING THE GAIN OF THE RADIOMETER SYSTEM IN SYNCHRONISM WITH THE SWITCHING BETWEEN THE ANTENNA AND THE REFERENCE TERMINATION, THE OUTPUT OF THE RADIOMETER CAN BE NULLED TO ZERO. THUS, WHEN THE RADIOMETER GAIN IS INCREASED BY A FACTOR, Y, THE POWER AT THE OUTPUT OF THE RADIOMETER CAN BE EQUATED FOR BOTH HALVES OF THE SWITCHING CYCLE, RESULTING IN A ZERO SWITCH-RATE FREQUENCY COMPONENT. AS LONG AS THE RADIOMETER OPERATES IN ITS LINEAR REGION, GAIN MODULATION CAN BE APPLIED ANYWHERE BETWEEN ANTENNA AND DETECTOR TO ACHIEVE NULL.

32. PHENOMENA OBSERVED

PASSIVE MICROWAVE EMISSIONS FROM EARTH'S SURFACE

33. MEASUREMENT RANGE

L-BAND

34. PRECISION AND ACCURACY

BETTER THAN 1 DEG K

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
1.4 TO 1.427 GHZ	1.0 DEG K	1.0 SECOND

38. FIELD OF VIEW	39. GROUND SWATH
15. DEG	63 NM WIDTH,80 % OVERLAP ALONG TRACK

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
15. DEG	63 NM (HALF POWER BEAM WIDTH.)

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		235N M	50 DEG

46. SPECIAL REQUIREMENTS
ANTENNA & COLD REFERENCE LOAD REQUIRE UNOBSTRUCTED FIELD OF VIEW

47. COMPONENTS
ANTENNA, RECEIVER, REFERENCE LOADS, RECORDER, ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
38 LB	10.3 CU FT	10 WATTS		15 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
HOT&COLD REFERENCE LOADS	FROM RETURNED TAPES	CONTINUOUS

62. TELEMETRY REQUIREMENTS
NA

63. ADVANTAGES AND LIMITATIONS
LONG WAVELENGTH OF SYSTEM WILL PROVIDE MEASUREMENTS WHICH ARE LESS AFFECTED BY METEOROLOGICAL CONDITIONS.

64. REFERENCES
EXPERIMENT IMPLEMENTATION PLAN FOR MANNED SPACEFLIGHT EXPERIMENT TITLE: L-BAND MICROWAVE RADIOMETER - SKYLAB A EREP USER'S HANDBOOK, NASA/MSC, FEB.1971

65. HISTORICAL REMARKS

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
LIMB-RADIANCE INVERSION EXPERIMENT	LIRAIN	EC1

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0006

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		ENG.MODEL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B.B.	NASA HDQTRS	OA/ERN	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
SANTA BARBARA RES CENTER	GOLETA, CALIFORNIA	12/72	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 CO2 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
14.0 TO 16.3 MICRONS

36. SPECTRAL RESOLUTION
NA

37. TIME CONSTANT

38. FIELD OF VIEW
0.03 DEG

39. GROUND SWATH
NA

40. ANGULAR RESOLUTION
NA

41. SPATIAL RESOLUTION

42. POINTING ACCURACY
1.0 DEG

43. POINTING RATE

44. ALTITUDE

45. INCLINATION

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

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
LIMB RADIANCE INVERSION	LRI	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0002

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
GILLE, J. C.	FLORIDA STATE UNIVERSITY	

9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
HOUSE, F. B.	DREXEL UNIVERSITY	

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

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B.B.	NASA HDQTRS	OA/ERN	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
		1974	

26. INSTRUMENT TYPE	27. SECURITY
RADIOMETER, IR	UNC

28. APPLICATION	29. SPACECRAFT
MET, PLANETARY ATMOSPHERES	NIMBUS-F

30. PURPOSE

PRIMARY-GLOBAL MEASUREMENT OF STRATOSPHERIC TEMPERATURE STRUCTURE AND WATER VAPOR AND OZONE DENSITY DISTRIBUTIONS*** SECONDARY-CALCULATION OF GEOSTROPIC WINDS FROM TEMPERATURE MEASUREMENTS.

31. PRINCIPLES OF OPERATION

A SCANNING IR RADIOMETER COUPLED WITH AN ATTITUDE REFERENCE UNIT WILL PRODUCE CALIBRATED RADIANCE PROFILES IN FOUR SPECTRAL INTERVALS BY MEASURING RADIATION EMANATING FROM AN ATMOSPHERIC PATH TANGENT TO A GEOCENTRIC CIRCLE. THE SINGLE AXIS ATTITUDE REFERENCE UNIT MEASURES THE EFFECTS OF SPACECRAFT MOTION ON THE RADIOMETER LINE OF SIGHT. PRECISE RELATIVE POINTING DIRECTION IS USED IN THE INFERENCE OF TEMPERATURE, OZONE AND WATER VAPOR DISTRIBUTIONS AS FUNCTIONS OF PRESSURE; WHEN COMBINED WITH METEOROLOGICAL (OR CLIMATOLOGICAL) DATA, THE GEOMETRIC HEIGHT SCALE IS OBTAINED. THE INSTRUMENT CONSISTS OF A RADIOMETER FRAME HOUSING ASSEMBLY AND INTERFACE ELECTRONICS UNIT. THE FORMER INCLUDES A TELESCOPE ASSEMBLY, SOLID CRYOGEN AND DETECTOR, DETECTOR BIAS AND PREAMP ELECTRONICS, AND ATTITUDE REFERENCE GYRO. THE TELESCOPE INCLUDES A BAFFLE SYSTEM, SCANNING MIRROR, COLLIMATOR TUNING FORK CHOPPERS, RELAY OPTICS, AND IN-FLIGHT CALIBRATION SUBASSEMBLY. THE SOLID CRYOGEN COOLER ASSEMBLY CONTAINS A PROTECTIVE WINDOW AT AMBIENT TEMPERATURE, COLD RELAY LENSES AND THE ARRAY OF HG-CD-TE DETECTORS WITH FILTERS DEPOSITED ON THEM, AS WELL AS THE METHANE PRIMARY CRYOGEN (65K) AND AMMONIA SECONDARY (165K).

32. PHENOMENA OBSERVED

HORIZON'S EMITTED RADIANCES IN FOUR IR SPECTRAL REGIONS

33. MEASUREMENT RANGE

8.8-10.1, 14.6-15.9, 14.2-17.1, 20-25 MICRONS

34. PRECISION AND ACCURACY

TEMP +-3 DEG K, WIND +-7 M/SEC, OZONE +- 18%, WATER VAPOR +-53%.

35. SPECTRAL RANGE
8.8 TO 25 MICRONS

36. SPECTRAL RESOLUTION

37. TIME CONSTANT

38. FIELD OF VIEW

39. GROUND SWATH

40. ANGULAR RESOLUTION

41. SPATIAL RESOLUTION

42. POINTING ACCURACY

43. POINTING RATE

44. ALTITUDE
MED CIRCULAR

45. INCLINATION
SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS
CRYOGENIC TEMPERATURES MUST BE MAINTAINED

47. COMPONENTS
RADIOMETER, COOLER, ELECTRONICS

48. WEIGHT
89 LB

49. VOLUME
3.2 CU FT

50. AVERAGE POWER
37 WATTS

51. STANDBY POWER

52. PEAK POWER

53. MTBF

54. RF INTERFERENCE

55. MAGNETIC INTERFERENCE

56. NUCLEAR INTERFERENCE

57. THERMAL INTERFERENCE
SENSITIVE

58. SHIELDING

59. CALIBRATION

60. DATA RECOVERY
TELEMETRY

61. FREQUENCY OF OBSERVATION
CONTINUOUS

62. TELEMETRY REQUIREMENTS

63. ADVANTAGES AND LIMITATIONS
DATA OBTAINED WILL REPRESENT SIGNIFICANT ADVANCES OVER EXISTING INSTRUMENTATION ALLOWING SOLUTION OF MANY OUTSTANDING PROBLEMS.

64. REFERENCES
PRELIMINARY DATA SHEET FOR NIMBUS-F, NOV., 1970.

65. HISTORICAL REMARKS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
LOW-RESOLUTION INFRARED RADIOMETER	LRIR	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0007

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
MCDONALD, T.	NESC/NOAA	202-655-4000
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
CPFF					POST FLIGHT

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GLOVER, J.C.	NESC/NOAA		202-655-4000

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	

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 ANOIZED 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

EARTH ALBEDO-ENERGY RADIATED TO SPACE BY EARTH

33. MEASUREMENT RANGE

NEAR UV, VISIBLE, NEAR IR, THERMAL IR

34. PRECISION AND ACCURACY

5 K DEG IN THERMAL IR

35. SPECTRAL RANGE
0.3 TO 30.0 MICRONS

36. SPECTRAL RESOLUTION

37. TIME CONSTANT
CONTINUOUS

38. FIELD OF VIEW
SEE ITEM 31

39. GROUND SWATH
LIMB-TO-LIMB(4200 NM)FROM 750 NM ALTITUDE

40. ANGULAR RESOLUTION
NA

41. SPATIAL RESOLUTION

42. POINTING ACCURACY

43. POINTING RATE

44. ALTITUDE
MED CIRCULAR

45. INCLINATION
SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS
NONE

47. COMPONENTS
8 SENSORS (THERMISTORS), ELECTRONICS, RECORDER

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
7 LB	0.75 CU FT				1 YEAR

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
INSTRUMENT IS BROAD RANGE, LOW ACCURACY TYPE.

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 PROCESSINGO OF 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.

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
LOW-RESOLUTION INFRARED RADIOMETER	LRIR	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
MCDONALD, T.	NESC/NOAA	202-655-4000
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/NOAA		202-655-4000

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	

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 ANOIZED 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 PROCESSINGO OF 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.

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
LOW-RESOLUTION INFRARED RADIOMETER	LRIR	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0007

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
MCDONALD, T.	NESC/NOAA	202-655-4000
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
CPFF					POST-FLIGHT

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GLOVER, J.C.	NESC/NOAA		202-655-4000

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

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

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 ANOIZED 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

EARTH ALBEDO-ENERGY RADIATED TO SPACE BY EARTH

33. MEASUREMENT RANGE

NEAR UV, VISIBLE, NEAR IR, THERMAL IR

34. PRECISION AND ACCURACY

5 K DEG IN THERMAL IR

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

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
(A	

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

46. SPECIAL REQUIREMENTS
NONE

47. COMPONENTS
8 SENSORS (THERMISTORS), ELECTRONICS, RECORDER

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
7 LB	0.75 CU FT				1 YEAR

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

INSTRUMENT IS BROAD RANGE, LOW ACCURACY TYPE

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 PROCESSINGO OF 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.

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE: LOW-RESOLUTION INFRARED RADIOMETER		2. ACRONYM: LRIR	3. EXP NO:
(TITLE CONT.)		4. RESUME DATE: 09/01/72	5. VERSION: 0007

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
MCDONALD, T.	NESC/NOAA	202-655-4000
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
CPFF					POST-FLIGHT

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GLOVER, J.C.	NESC/NOAA		202-655-4000

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

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

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 ANOIZED 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

EARTH ALBEDO-ENERGY RADIATED TO SPACE BY EARTH

33. MEASUREMENT RANGE

NEAR UV, VISIBLE, NEAR IR, THERMAL IR

34. PRECISION AND ACCURACY

5 K DEG IN THERMAL IR

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

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
NA	

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

46. SPECIAL REQUIREMENTS
NONE

47. COMPONENTS
8 SENSORS (THERMISTORS), ELECTRONICS, RECORDER

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
7 LB	0.75 CU FT				1 YEAR

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
INSTRUMENT IS BROAD RANGE, LOW ACCURACY TYPE.

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 PROCESSINGO OF 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.

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
LOW-RESOLUTION NONSCANNING RADIOMETER	LRNR	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
HANEL, DR. R.	GODDARD SPACE FLT CENTER	301-982-5042
9. CO-INVESTIGATOR	**10. ORGANIZATION**	**11. TELEPHONE**
STAMPFL, DR. R.A.	GODDARD SPACE FLT CENTER	301-982-5042

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
TEPPER, M.	NASA HDQTRS	OA/ERD	202-755-2322

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

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
LOW-RESOLUTION NONSCANNING RADIOMETER	LRNR	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
HANEL, DR. R.	GODDARD SPACE FLT CENTER	301-982-5042
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
STAMPFL, DR. R.A.	GODDARD SPACE FLT CENTER	301-982-5042

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
TEPPER, M.	NASA HDQTRS	OA/ERD	202-755-2322

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
0.2 TO 50.0 MICRONS

36. SPECTRAL RESOLUTION
SEE ITEM 31

37. TIME CONSTANT

38. FIELD OF VIEW
50.0 DEG

39. GROUND SWATH
470 NM DIAM CIRCLE FROM 475 NM ALTITUDE

40. ANGULAR RESOLUTION
50.0 DEG

41. SPATIAL RESOLUTION
470 NM DIAM CIRCLE FROM 475 NM ALTITUDE

42. POINTING ACCURACY

43. POINTING RATE

44. ALTITUDE
MED CIRCULAR

45. INCLINATION
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 AVAIL-ABLE FROM WORLD DATA CENTER, ASHEVILLE, N.C.

65. HISTORICAL REMARKS
IDENTICAL INSTRUMENT FLOWN ON TIROS 2 , 3, AND 4.

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
LOW-RESOLUTION NONSCANNING RADIOMETER	LRNR	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
HANEL, DR. R.	GODDARD SPACE FLT CENTER	301-982-5042
9. CO-INVESTIGATOR	**10. ORGANIZATION**	**11. TELEPHONE**
STAMPFL, DR. R.A.	GODDARD SPACE FLT CENTER	301-982-5042

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
TEPPER, M.	NASA HDQTRS	OA/ERD	202-755-2322

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 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 AVAIL-. ABLE FROM WORLD DATA CENTER, ASHEVILLE, N.C.

65. HISTORICAL REMARKS
IDENTICAL INSTRUMENT FLOWN ON TIROS 2, 3, AND 4

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
LOW-RESOLUTION OMNIDIRECTIONAL RADIOMETER	LROR	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	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	OSS/SG	202-755-2322

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 HEMI-SPHERES 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 TEMPERA TURE IS MEASURED BY A GLASS COATED BEAD THERMISTOR MOUNTED ON THE HEMISPHERE. ALSO, PROVISION IS MADE TO MEASURE THE TEMPERA-TURE 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 RADIA-TION THAN TO SOLAR RADIATION. A FOURTH WITH A GOLD METAL SURFACE IS MORE SENSITIVE TO SOLAR RADIATION THAN TO TERRESTRIAL RADIA-TION. 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 MEA-SURE 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
30.0 DEG	300 NM DIAM 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.

65. HISTORICAL REMARKS

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
LOW-RESOLUTION OMNIDIRECTIONAL RADIOMETER	LROR	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	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
TEPPER, M.	NASA HDQTRS	OA/ERD	202-755-2322

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.

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 (55 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.BECAUSE OF THE LIMITED TELEMETRY CAPABILITY, 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 2 TEMPERATURES FROM MATCHED THERMISTORS. 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

ABSORBED IRRADIANCE FROM SUN AND EARTH;ENERGY EMITTED FROM 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
55.0 DEG	500 NM DIAM CIRCLE FR3M 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)RADIATION BALANCE OF THE EARTH FROM A SATELLITE. HOUSE, F.B., PHD THESIS,U. OF WISC. 1965.***2)SATELLITE AND ROCKET EXPTS, NAT SPACE SCI DATA CENTER, NASA/GSFC,JAN 68.***3)MISSION PLAN TIROS 7. GSFC REPORT NO. X-650-63-99, MAY 63.***4)JUNO 2 SUMMARY PROJ. REPORT VOL 1, EXPLORER 7, NASA TN-D-608,JULY 61.***5)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

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
LOW-RESOLUTION OMNIDIRECTIONAL RADIOMETER	LROR	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	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
TEPPER, M.	NASA HDQTRS	OA/ERD	202-755-2322

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.

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 (55 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. BECAUSE OF THE LIMITED TELEMETRY CAPIBILITY, 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 2 TEMPERATURES FROM MATCHED THERMISTORS. 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

IR ENERGY ABSORBED FROM SUN AND EARTH AND EMITTED BY THE EARTH

33. MEASUREMENT RANGE

128 DEG K TO 488 DEG K

34. PRECISION AND ACCURACY

0.1 KELVIN DEGREE

35. SPECTRAL RANGE
0.3 TO 60.0 MICRON

36. SPECTRAL RESOLUTION
NA

37. TIME CONSTANT
5 SECONDS

38. FIELD OF VIEW
55.0 DEG

39. GROUND SWATH
470 NM DIAM CIRCLE FROM 450 NM ALTITUDE

40. ANGULAR RESOLUTION
NA

41. SPATIAL RESOLUTION

42. POINTING ACCURACY
NA

43. POINTING RATE
NA

44. ALTITUDE
MED CIRCULAR

45. INCLINATION
MEDIUM POSIGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS
2 DETECTION DEVICES, ELECTRONICS

48. WEIGHT
3 LB

49. VOLUME

50. AVERAGE POWER
1 WATT

51. STANDBY POWER

52. PEAK POWER

53. MTBF

54. RF INTERFERENCE

55. MAGNETIC INTERFERENCE

56. NUCLEAR INTERFERENCE

57. THERMAL INTERFERENCE
SENSITIVE

58. SHIELDING
MIRRORS SHIELD SENSORS

59. CALIBRATION

60. DATA RECOVERY
DELAYED TELEMETRY

61. FREQUENCY OF OBSERVATION
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)RADIATION BALANCE OF THE EARTH FROM A SATELLITE. HOUSE,F.B., PHD THESIS,U.OF WISC. 1965.***2)SATELLITE AND ROCKET EXPTS, NAT SPACE SCI DATA CENTER, NASA/GSFC,JAN 68.***3)MISSION PLAN TIROS 7. GSFC REPORT NO. X-650-63-99, MAY 63.***4)JUNO 2 SUMMARY PROJ. REPORT VOL 1, EXPLORER 7, NASA TN-D-6/8,JULY 61.***5)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

F

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
LOW-RESOLUTION OMNIDIRECTIONAL RADIOMETER	LROR	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	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
TEPPER, M.	NASA HDQTRS	OA/ERD	202-755-2322

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.

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 (55 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. THERMISTORS, FASTENED INSIDE OF THE HEMISPHERIC SHELLS, GIVE THEIR TEMPERATURES. BECAUSE OF THE LIMITED TELEMETRY CAPABILITY, MATCHED PAIRS OF THERMISTORS ARE CONNECTED IN SERIES WITH SIMILAR SENSORS ON OPPOSIDE SIDES OF THE SPACECRAFT. THEREFORE, THE MEASURED SENSOR TEMPERATURE RECEIVED FROM THE SATELLITE IS AN AVERAGE OF 2 TEMPERATURES FROM MATCHED THERMISTORS. 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

ABSORBED IRRADIANCE FROM SUN AND EARTH;ENERGY EMITTED FROM 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
	400 NM DIAM 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)RADIATION BALANCE OF THE EARTH FROM A SATELLITE. HOUSE, F.B., PHD THESIS,U. OF WISC. 1965.***2)SATELLITE AND ROCKET EXPTS, NAT SPACE SCI DATA CENTER, NASA/GSFC,JAN 68.***3)MISSION PLAN TIROS 7. GSFC REPORT NO. X-650-63-99, MAY 63.***4)JUNO 2 SUMMARY PROJ. REPORT VOL 1, EXPLORER 7, NASA TN-D-608,JULY 61.***5)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

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
MEDIUM-RESOLUTION INFRARED RADIOMETER	MRIR	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
MCCULLOCH, A.	GODDARD SPACE FLT CENTER	301-982-5042
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.	OA/ERN	202-755-2322

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	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(CO2) 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.

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
MEDIUM-RESOLUTION INFRARED RADIOMETER	MRIR	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
MCCULLOCH, A.	GODDARD SPACE FLT CENTER	301-982-5042
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	OA/ERN	202-755-2322

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 ELECTRCMAGNETIC 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 MSEC

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

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
MEDIUM-RESOLUTION RADIOMETER	MRR	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
NORDBERG, DR. W.	GODDARD SPACE FLT CENTER	301-982-5042

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
TEPPER, M.	NASA HDQTRS	OA/ERD	202-755-2322

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 NMDIAM 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)

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
MEDIUM-RESOLUTION RADIOMETER	MRR	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
NORDBERG, DR. W.	GODDARD SPACE FLT CENTER	301-982-5042

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
TEPPER, M.	NASA HDQTRS	OA/ERD	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
BARNES ENGINEERING CO.	STAMFORD, CONN.	7/61	

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. 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.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)

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
MEDIUM-RESOLUTION RADIOMETER	MRR	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
NORDBERG, DR. W.	GODDARD SPACE FLT CENTER	301-982-5042
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
TEPPER, M.	NASA HDQTRS	OA/ERD	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
BARNES ENGINEERING CO.	STAMFORD, CONN.	2/62	

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 THE 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 A+ CENTER 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)

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
MEDIUM-RESOLUTION RADIOMETER	MRR	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
MCCULLOCH, A.	GODDARD SPACE FLT CENTER	301-982-5042
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
TEPPER, M.	NASA HDQTRS	OA/ERD	202-755-2322

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)

G

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
MICROWAVE RADIOMETER/SCATTEROMETER AND ALTIMETER	MRSA	5-193

(TITLE CONT.)	4. RESUME DATE	5. VERSION
FACILIY: EARTH RESOURCES EXP. PACKAGE (EREP)	09/01/72	00C4

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
EVANS, D.	MANNED SPACECRAFT CENTER	713-483-0123

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
					ENG.MODEL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
FISCHETTI, T.L.	NASA HDQTRS	OA/ERS	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
GENERAL ELECTRIC CO.		1973	

26. INSTRUMENT TYPE	27. SECURITY
MICROWAVE RADIOMETER/SCATTEROMETER AND ALTIMETER	UNC

28. APPLICATION	29. SPACECRAFT
ERSP	SKYLAB-A

30. PURPOSE

PRIMARY-TO PROVIDE SIMULTANEOUS EVALUATIONS OF RADAR BACKSCATTERING CROSS-SECTION AND PASSIVE MICROWAVE EMISSIVITY OF LAND AND SEA***SECONDARY-TO PROVIDE DATA FOR USE IN DESIGNING A RADAR ALTIMETER FOR SPACE USE***TERTIARY-TO OBTAIN INITIAL VALUE DATA FOR THE ATMOSPHERE ABOVE THE BOUNDARY LAYER TO AID IN NUMERICAL WEATHER PREDICTION.

31. PRINCIPLES OF OPERATION

THE ACTIVE/PASSIVE MICROWAVE SYSTEM IS A COMBINATION RADAR SCATTEROMETER AND PASSIVE MICROWAVE RADIOMETER OPERATING AT 13.9GHZ. THE ALTIMETER OPERATES INDEPENDENTLY. THE EXPERIMENT IS BASED ON SIMULTANEOUS MEASUREMENTS OF RADAR DIFFERENTIAL BACKSCATTERING CROSS SECTION AND PASSIVE MICROWAVE EMISSIVITY OF LAND AND SEA SURFACES. THE ANTENNA IS A 4 FOOT MECHANICALLY SCANNING PARABOLIC REFLECTOR WITH A 1.4 DEG HALF-POWER CONICAL PENCIL BEAM. ON THE NON-CONTIGUOUS "ALONG TRACK" AND "CROSS TRACK" SCANNING MODES THE ANTENNA MOVES IN DISCRETE STEPS (0, 15, 30, 40, AND 48 DEG) FROM ONE CELL TO ANOTHER DWELLING ON EACH CELL A PREDETERMINED PERIOD OF TIME. DURING CONTIGUOUS SCAN MODES THE ANTENNA MOVES CONTINUOUSLY EITHER ALONG TRACK (0 TO 48 DEG) OR CROSS-TRACK (+-12.5 DEG CENTERED ON ROLL ANGLES OF +-30, +-15 AND 0 DEG AT PITCH ANGLES OF 0, 15, 30, 40, AND 48 DEG).
THE ALTIMETER, A NARROW PULSE RADAR, TRANSMITS A 100 OR 10 NANOSECOND PULSE AT A PRR OF 360/SECOND AND A PEAK POWER OF 2 KILOWATTS. THE RECEIVED SIGNAL IS DOWN-CONVERTED AND SQUARE-LAW DETECTED. THE ALTIMETER ALSO PERFORMS IN-PHASE AND QUADRATURE DETECTION.

32. PHENOMENA OBSERVED

RADAR DIFFERENTIAL BACKSCATTERING, PASSIVE MICROWAVE EMISSIVITY

33. MEASUREMENT RANGE

KU-BAND

34. PRECISION AND ACCURACY

TRACKER HAS NOISE LEVEL <1-METER RMS AT S/N RATIOS =OR> 20 DB

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
13.9 GHZ	NA	4.5 SEC

38. FIELD OF VIEW	39. GROUND SWATH
SEE ITEM 31	342 NM

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
1.4 DEG	6 NM CONE AT NADIR

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
0.5 DEG	16.0 DEG/SEC	235 NM	50 DEG

46. SPECIAL REQUIREMENTS

ANTENNA REQUIRES UNOBSTRUCTED VIEW +-48 DEG FROM NADIR.

47. COMPONENTS

RADIOMETER, SCATTEROMETER, ALTIMETER, ANTENNA, ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
210 LB	24.2 CU FT	153 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
COLD SKY REFERENCE LOAD	FROM TAPE/10 KILOBIT	CONTINUOUS

62. TELEMETRY REQUIREMENTS

NA

63. ADVANTAGES AND LIMITATIONS

CAN OPERATE BOTH DAY AND NIGHT AND GENERALLY IS NOT AFFECTED BY CLOUDS AND WEATHER.

64. REFERENCES

1. EXPERIMENT IMPLEMENTATION PLAN FOR MANNED SPACEFLIGHT EXPERIMENTS, TITLE: MICROWAVE RADIOMETER SCATTEROMETER-11/21/69;
2. EARTH RESOURCES REMOTE SENSING SYSTEMS, MSC P6-0406-NOV.1970.
3. OPPORTUNITIES FOR PARTICIPATION IN SPACE FLIGHT INVESTIGATIONS, MEMO CHANGE 33, DEC. 22, 1970.
4. SKYLAB-A, EREP USERS HANDBOOK, NASA MSC, FEB.1971.

65. HISTORICAL REMARKS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
MULTI-SPECTRAL SCANNER	MSS	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
ARLAUSKAS, J.	GODDARD SPACE FLT CENTER	301-982-5042
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
CPFF	NAS5-11255		11/69	8/71	OPERATIONAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B.	NASA HDQTRS	OA/ERN	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
HUGHES AIRCRAFT CO.	EL SEGUNDO, CALIF.	7/72	NA

26. INSTRUMENT TYPE	27. SECURITY
RADIOMETER,	UNC

28. APPLICATION	29. SPACECRAFT
ERSP, AGRI, GEOG, GEOL, OCEAN	ERTS-1&B

30. PURPOSE

PRIMARY-TO PROVIDE RADIOMETRIC DATA (FOUR SPECTRAL BANDS ON ERTS-A: 0.5-0.6, 0.6-0.7, 0.7-0.8, 0.8-1.1 MICRONS; A FIFTH BAND ON ERTS-B: 10.4-12.6 MICRONS) ALLOWING IDENTIFICATION, ANALYSIS, AND IMAGERY OF EARTH TARGETS.

31. PRINCIPLES OF OPERATION

THE MSS HAS A 2-ELEMENT CASSEGRAIN MIRROR SYSTEM (F/3.6) WITH A 9-IN DIAMETER PRIMARY AND A ROCKING SCAN MIRROR, LOCATED IN THE OBJECT PLANE, WITH CROSS-ORBITAL-TRACK SWEEP RATE OF 13.6 HZ. THE IMAGE IS FOLDED TWICE AND FOCUSED ON A SQUARE FIBER OPTIC MATRIX. INDIVIDUAL FIBERS COUPLE THE FOCUSED OPTICAL ENERGY TO A BAND FILTER AND DETECTOR ASSEMBLY. BANDS 1,2,&3 UTILIZE TRI-AXIAL PHOTOMULTIPLIER TUBES WHILE BAND 4 USES SILICON PHOTO-DIODES. SIX DETECTORS ARE PARALLELED IN EACH OF THE FIRST FOUR BANDS BY A ROW OF FIBER OPTIC BUNDLES STACKED IN THE DIRECTION OF THE ORBITAL TRACK PERMITTING A SLOWER SCANNING MOTION OF THE ROCKING MIRROR SYSTEM. TWO DETECTORS ARE USED IN THE THERMAL BAND. THE BASIC MSS SCAN LINE SYNCHRONIZATION IS PROVIDED BY AN OPTICAL PULSE GENERATOR. A MULTIPLEXER IS INCLUDED IN THE MSS AND PROCESSES THE VIDEO DATA. THE 24 (OR 26) CHANNELS OF VIDEO ARE TIME-DIVISION-MULTIPLEXED INTO A SINGLE DATA STREAM OF APPROXIMATELY 2.4 MHZ. THE MULTIPLEXED SIGNAL IS THEN CONVERTED INTO A 15 MB/S PCM SIGNAL BY AN A/D CONVERTER. LINE START, PCM FORMAT INFORMATION, AND CALIBRATION DATA ARE INCLUDED IN THE MULTIPLEXER OUTPUT SIGNAL.

32. PHENOMENA OBSERVED

REFLECTED SOLAR AND THERMAL RADIATION FROM THE EARTH

33. MEASUREMENT RANGE

VISIBLE AND NEAR INFRARED RADIATION

34. PRECISION AND ACCURACY

S/N 17-39 DB DEPENDING ON RADIANCE LEVEL AND BAND (FREQUENCY)

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.5 TO 12.6 MICRONS		

38. FIELD OF VIEW	39. GROUND SWATH
11.6 BY 0.03 DEG	100 NM BY 1556 FT FROM 492 NM ALTITUDE.

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.005 DEG	259FT BY 1556 FT FROM 492 NM ALTITUDE

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

46. SPECIAL REQUIREMENTS

OPERATING THERMAL RANGE: 10 TO 30 DEG.C

47. COMPONENTS

TELESCOPE, SCAN MECHANISM, FIBER AND RELAY OPTICS, DETECTORS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
136 LB	6.1 CU FT	55 WATTS			12 MON

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

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
ROUTINE IN-FLIGHT CALIB.	DELAYED AND REALTIME	CONTINUOUS

62. TELEMETRY REQUIREMENTS

60 ANALOG CHANNELS; 39 DIGITAL POINTS

63. ADVANTAGES AND LIMITATIONS

FIRST MULTI-SPECTRAL SATELLITE RADIOMETER

64. REFERENCES

1) MULTISPECTRAL SCANNER SYSTEM FOR ERTS (DOCUMENT OBTAINED FROM J. ARLAUSKAS) 2) PROJECT PLAN FOR EARTH RESOURCES TECHNOLOGY SATELLITE (ERTS-A/B) COMBINED PHASE B AND C

65. HISTORICAL REMARKS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

Field	Value
1. TITLE	NIMBUS E MICROWAVE SPECTROMETER
(TITLE CONT.)	
2. ACRONYM	NEMS
3. EXP NO	E07
4. RESUME DATE	09/01/72
5. VERSION	0009
6. PRINCIPAL INVESTIGATOR	STAELIN, DR. D.H.
7. ORGANIZATION	MASS INST OF TECHNOLOGY
8. TELEPHONE	617-864-6900-X3711
9. CO-INVESTIGATOR	BARATH, F. T., ET AL
10. ORGANIZATION	JET PROPULSION LAB
11. TELEPHONE	213-354-3025
12. CONTRACT TYPE	
13. CONTRACT NUMBER	
14. FLASH INDEX NUMBER	
15. START DATE	01/69
16. COMPLETION DATE	
17. STATUS	ENG.MODEL
18. MONITOR	SCHARDT, B.B.
19. AGENCY	NASA HDQTRS
20. PGM OFFICE	OA/ERN
21. TELEPHONE	202-755-2322
22. VENDOR	JET PROPULSION LAB
23. LOCATION	PASADENA, CALIFORNIA
24. FLIGHT DATE	12/72
25. LEAD TIME	36 MONTHS
26. INSTRUMENT TYPE	RADIOMETER, 5-CHANNEL DICKE SUPERHETERODYNE MICROWAVE
27. SECURITY	UNC
28. APPLICATION	MET
29. SPACECRAFT	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 22.4, 31.4 AND 53.65, 60.82 AND 64.42 GHZ NEAR THE 5-MM WATER VAPOR AND 1.35-CM OXYGEN RESONANCES RESPECTIVELY. THREE DISCRETE LAYERS OF THE ATMOSPHERE ARE SOUNDED TO INFER A TEMPERATURE PROFILE; LIKEWISE TWO DISCRETE LEVELS ARE SOUNDED FOR THE WATER VAPOR PROFILES. 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 AND COLD AND HOT REFERENCES.

32. PHENOMENA OBSERVED

ATMOSPHERIC AND SURFACE RADIATION IN THE 0.5 TO 1.35 CM BANDS

33. MEASUREMENT RANGE

RADIANT TEMPERATURE FROM 175 TO 400 DEG 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
		MED	SUN-SYNCH HIGH NOON

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	THERM. STBLZD TO 25+-5C

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
HOT & COLD REFERENCES	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

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
PRESSURE MODULATED CO2 RADIOMETER FOR UPPER	PMCR	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
ATMOSPHERE SOUNDING	09/01/72	0002

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
HOUGHTON, J. T.	OXFORD UNIVERSITY	
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
RODGERS, C. D.	OXFORD UNIVERSITY	

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

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B.B.	NASA HDQTRS	OA/ERN	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
		1974	

26. INSTRUMENT TYPE	27. SECURITY
RADIOMETER, IR	UNC

28. APPLICATION	29. SPACECRAFT
MET, PLANETARY ATMOSPHERES	NIMBUS-F

30. PURPOSE

PRIMARY-TO OBTAIN RADIOMETRIC MEASUREMENTS OF TEMPERATURE IN TWO SELECTED REGIONS AT ALTITUDES BETWEEN 45 AND 70 KM ON A GLOBAL SCALE.

31. PRINCIPLES OF OPERATION

THE PRESSURE BROADENED EMISSION LINES OF CO2 BECOME SO NARROW IN THE UPPER STRATOSPHERE AND MESOSPHERE THAT CONVENTIONAL SPECTROMETERS AND INTERFEROMETERS HAVE INSUFFICIENT SPECTRAL RESOLUTION TO SELECT THE RADIATION FROM THESE LEVELS. THE PRESSURE MODULATION TECHNIQUE PERMITS THE EXTENSION OF SELECTIVE CHOPPING TECHNIQUES TO THE HIGHER ALTITUDES. THE INSTRUMENT COMPRISES TWO SIMILAR RADIOMETER CHANNELS CONTAINING LEVELS, FILTERS, CO2 CELLS, CONICAL LIGHT PIPE TO WHICH DETECTORS ARE COUPLED. THE WEIGHTING FUNCTIONS FOR EACH RADIOMETER ARE SELECTED BY CHOOSING A MEAN CELL PRESSURE OF 0.325-MB FOR CHANNEL ONE AND 2.25 MB FOR CHANNEL TWO. THE LENGTH OF THE CELLS ARE THE SAME, SIX CENTIMETERS. THE HEIGHT OF THE WEIGHTING FUNCTION PEAKS ARE 65-KM FOR CHANNEL ONE AND 50-KM FOR CHANNEL TWO. THE MODULATION FREQUENCY IS 15-HZ. THIS WILL PERMIT MEASUREMENTS OF MESOSPHERIC TEMPERATURES TO BETTER THAN +-2 DEG K AT 65 KM AND +-0.2 DEG K AT 50-KM. PROPOSED DETECTORS ARE PYROELECTRIC (TRIGLYCINE SULPHATE).

32. PHENOMENA OBSERVED

EARTH'S EMITTED RADIANCE AT 15 MICRONS

33. MEASUREMENT RANGE

15-MICRON CO2 BAND

34. PRECISION AND ACCURACY

SEE ITEM 31

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
15 MICRONS		

38. FIELD OF VIEW	39. GROUND SWATH
10. DEG	

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
10 DEG	100 NM FROM 600 NM ORBIT

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
5 LB	0.25 CU FT	3 WATTS			

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

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

62. TELEMETRY REQUIREMENTS

63. ADVANTAGES AND LIMITATIONS

64. REFERENCES
PRELIMINARY DATA SHEET FOR NIMBUS-F, NOV., 1970.

65. HISTORICAL REMARKS

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
PASSIVE MICROWAVE IMAGING SYSTEM	PMIS	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	05/20/71	0001

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
MATHEWS, R. E.	MANNED SPACECRAFT CENTER	713-483-3111
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
					PREFLT TEST

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
		08/71	

26. INSTRUMENT TYPE	27. SECURITY
RADIOMETER/IMAGER, MICROWAVE	UNC

28. APPLICATION	29. SPACECRAFT
ERSP	NP3A A/C

30. PURPOSE

PRIMARY-TO GATHER TWO-DIMENSIONAL, QUANTITATIVE, ANTENNA TEMPERATURE DATA OVER A VARIETY OF TARGETS.

31. PRINCIPLES OF OPERATION

THE RADIOMETER SUBSYSTEM INCLUDES THE RADOME, ANTENNA, AND RADIOMETER. THE ANTENNA WILL BE A TWO-DIMENSIONAL PHASED ARRAY, ELECTRICALLY STEPPED TO ACHIEVE SCANNING TRANSVERSE TO THE FLIGHT PATH. THE ANTENNA WILL BE A DUAL-POLARIZATION DEVICE WITH TWO OUTPUT PORTS. A SCAN ANGLE OF +-35 DEG TRANSVERSE TO THE FLIGHT LINE WILL RESULT IN 50 SCAN POSITIONS. SCAN STEPS SHALL BE SIZED TO PRODUCE A 20 TO 30 PERCENT OVERLAP OF SUCCESSIVE BEAMS; PROVISION IS MADE TO STOP THE BEAM SCAN AND MANUALLY STEP THROUGH ALL POSITIONS. THE RADIOMETER HAS A BANDWIDTH OF LESS THAN 150 MHZ (3-DB POINTS) RMS SENSITIVITY. THE AIRBORNE CONTROL AND DISPLAY SUBSYSTEM INCLUDES THE EQUIPMENT NECESSARY TO CONTROL AND MONITOR THE IMAGING RADIOMETER SUBSYSTEM WHICH INCLUDES A SWITCHABLE, REAL-TIME DIGITAL READOUT FOR MONITORING THE INSTRUMENT AND ENGINEERING OUTPUTS. A REAL-TIME IMAGE PRESENTATION PROVIDES QUICK-LOOK CAPABILITY AND A FRAMING CAMERA RECORDS DATA FOR VERIFICATION OF SYSTEM OPERATION. RADIOMETER OUTPUT DATA WILL BE RECORDED ON 35-MM BLACK-AND-WHITE FILM. AN ADAS NUMERIC DISPLAY WILL BE REQUIRED IN THE FILM RECORDING UNIT. RECORDER WILL RECORD A MINIMUM OF 45 MINUTES OF DATA WHILE AT THE HIGHEST V/H RATE.

32. PHENOMENA OBSERVED

MICROWAVE RADIATION EMITTED FROM EARTH'S SURFACE

33. MEASUREMENT RANGE

SHF FREQUENCY

34. PRECISION AND ACCURACY

<2.0 DEG K AT U/H 0.2; <0.5 DEG K AT V/H 0.01;

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
10.69 TO 150. MHZ	+-5 MHZ	10 MILLISEC

38. FIELD OF VIEW	39. GROUND SWATH
1.8 BY 3 DEG	314 FT BY 524 FT FROM 10,000 FT

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
1.8 DEG	314 FT AT 10,000 FT ALTITUDE

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

46. SPECIAL REQUIREMENTS

47. COMPONENTS
RADIOMETER, ANTENNA, DISPLAY SUBSYSTEM

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
		CONTINUOUS

62. TELEMETRY REQUIREMENTS
NA

63. ADVANTAGES AND LIMITATIONS

64. REFERENCES
1. MSC AIRCRAFT CAPABILITIES MANUAL, PP. 2-57 TO 2-66

65. HISTORICAL REMARKS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

GODDARD SPACE FLIGHT CENTER

GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
SURFACE-COMPOSITION MAPPING RADIOMETER	SCMR	E23
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0009

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
HOVIS, DR. W. A.	GODDARD SPACE FLT CENTER	301-982-5042
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		ENG.MODEL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B.B.	NASA HDQTRS	OA/ERN	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
		12/72	33 MONTHS

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

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 THREE CHANNELS: 0.7-1.4, 8.3-9.3 AND 10.2-11.2 MICRONS, 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 (D*) OF ABOUT 10 TO THE TENTH AT 100 DEG 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		50KHZ/CHANNEL

38. FIELD OF VIEW	39. GROUND SWATH
60. BY 0.035DEG	700 NM BY 0.35 NM AT 600 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.035 DEG	0.35 NM BY 0.35 NM AT 600 NM 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

SCAN MIRROR, OPTICS $ DETECTOR,.ELECTRONICS,RADIANT 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	ON COMMAND

62. TELEMETRY REQUIREMENTS

2-CHANNEL XMITTER, 50 KHZ VIDEO PER CHANNEL, 40 DB SIN WILL REQUIRE 10**4 SAMPLES PER SECOND PER CHANNEL FOR MAXIMUM OF 10 MINUITES PER ORBIT; LESS IF RESOLUTION IS DEGRADED.

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.

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
SELECTIVE CHOPPER RADIOMETER	SCR	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0007

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
					OPERATIONAL

18. MONITOR	19. AGENCY	20. PGM.OFFICE	21. TELEPHONE
SCHARDT, B.B.	NASA HDQTRS	OA/ERN	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
UNIVERSITY OF OXFORD	OXFORD,ENGLAND	04/70	NA

26. INSTRUMENT TYPE	27. SECURITY
RADIOMETER, 3 DUAL-CHANNEL INFRARED	UNC

28. APPLICATION	29. SPACECRAFT
MET	NIMBUS-4

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

RADIATION FROM ATMOSPHERIC CARBON DIOXIDE.

33. MEASUREMENT RANGE

IR RADIATION IN 15 MICRON BAND.

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	1.0 SECONDS

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

SCR SENSOR HOUSINGS CANNOT EXCEED 40 DEG C

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. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	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

C3

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
SELECTIVE CHOPPER RADIOMETER	SCR	E05
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0009

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
HOUGHTON, DR.J. AND	CLARENDON LAB,OXFORD,ENG	0X5-9291
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
					ENG.MODEL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B.B.	NASA HDQTRS	OA/ERN	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
ELLIOT-AUTOMATION	ENGLAND	12/72	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

INSTRUMENT OBSERVES IN 16 CHANNELS FROM 2 TO 100 MICRONS. EIGHT CHANNELS OBSERVE IN THE 15-MICRON CO2 BAND, 1 SOUNDS WATER VAPOR DISTRIBUTION, ITS A CLEAR WINDOW CHANNEL, 2 OBSERVE REFLECTED SUNLIGHT, 2 CIRRUS CLOUDS, AND 2 NIGHT EMISSION FROM CLOUDS. CHANNEL SEPARATION IS OBTAINED BY OPTICAL FILTERING. THERE ARE 4 GROUPS OF 4 CHANNELS EACH: A)13.8-14.8, B)15.0, C)11-1-100,AND D)2.08-3.5 MICRONS. THE SENSOR IS BASED ON MIRROR OPTICS AND TIME-MULTIPLEXING OF THE 4 CHANNELS WITHIN EACH GROUP.THERE IS 1 DETECTOR AND ELECTRONIC SYSTEM FOR EACH GROUP. A FILTER WHEEL MOUNTED IN FRONT OF EACH DETECTOR CONTAINS 4 FILTERS (OR CO2 CELLS IN THE GROUP B CHANNELS) WHICH DEFINE THE 4 SPECTRAL INTER-VALS FOR THAT GROUP. IN THE LOWER CO2 TEMPERATURE SOUNDING CHANNELS, GROUP A, THE WEIGHTING FUNCTIONS MAY BE SHARPENED BY ABSORBING OUT THE LINE CENTERS OF EACH BAND BY MEANS OF A CO2 PATH LENGTH WITHIN THE OPTICAL SYSTEM. CONVERSELY, IN THE GROUP B CHANNELS, FOR SOUNDING IN THE UPPER ATMOSPHERE,GOOD VERTICAL RESOLUTION IS OBTAINED USING A DIFFERENCE TECHNIQUE BETWEEN ADJACENT CHANNELS BUT WITH INCREASING AMOUNTS OF THE LINE CENTERS ABSORBED OUT BY MEANS OF THE CO2-FILLED CELLS. THIS IS THE SELECTIVE CHOPPING PRINCIPLE FROM WHICH THE INSTRUMENT IS NAMED.

32. PHENOMENA OBSERVED

RADIATION FROM EARTH, ATMOSPHERE,CLOUDS

33. MEASUREMENT RANGE

0-200 ERGS/SEC/SQ-CM/STERADIAN/CM**-1

34. PRECISION AND ACCURACY

BETTER THAN 0.25 ERG/SEC/SQ-CM/STERADIAN/CM**-1

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
2. TO 100. MICRONS		1. SEC

38. FIELD OF VIEW	39. GROUND SWATH
1.5 BY 4.0 DEG	15NM AND 42 NM FROM 600 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
1.544 DEG	15 NM AND 42 NM FROM ORBIT

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
NA	NA	MED	SUN-SYNCH HIGH NOON

46. SPECIAL REQUIREMENTS
4 FILTER WHEELS TEMP MUST BE KEPT WITHIN 0.1 C DEG OF DETECTORS

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
BLACK BODY; SPACE VIEW	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

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
SCANNING RADIOMETER	SR	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0007

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
GEMUNDER, G.(T.MON)	GODDARD SPACE FLT CENTER	301-982-5042
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
FP					OPERATIONAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GARBACZ, M.	NASA HDQTRS	OA/ERO	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
SANTA BARBARA RES CENTER	GOLETA, CALIFORNIA	1/70	NA

26. INSTRUMENT TYPE	27. SECURITY
RADIOMETER, VISIBLE/IR SCANNING	UNC

28. APPLICATION	29. SPACECRAFT
MET,ATM-PHYS,PART-FLD	ITOS-1

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: 50-10,000 FT-LAMBERTS; IR TEMP:180-330 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		CONTINUOUS

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	2 NM VISIBLE, 4 NM IR 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	0.5 CU FT	14 WATTS			1 YEAR

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

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
SCANNING RADIOMETER	SR	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0007

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
GEMUNDER, G.(T.MON)	GODDARD SPACE FLT CENTER	301-982-5042
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
FP					OPERATIONAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GARBACZ, M.	NASA HDQTRS	OA/ERO	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
SANTA BARBARA RES CENTER	GOLETA,CALIF.	12/70	NA

26. INSTRUMENT TYPE	27. SECURITY
RADIOMETER, VISIBLE/IR SCANNING	UNC

28. APPLICATION	29. SPACECRAFT
MET, ATM-PHYS, PART-FLD	NOAA-1

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: 50-10,000 FT-LAMBERTS; IR TEMP:180-330 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		CONTINUOUS

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	2 NM VISIBLE, 4 NM IR 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	0.5 CU FT	14 WATTS			1 YEAR

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

FLOWN ON ITOS-1

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
SCANNING RADIOMETER	SR	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0007

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
GEMUNDER, G.(T.MON)	GODDARD SPACE FLT CENTER	301-982-5042

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
FP					OPERATIONAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GARBACZ, M.	NASA HDQTRS	OA/ERO	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
SANTA BARBARA RES CENTER	GOLETA,CALIF.	10/72	NA

26. INSTRUMENT TYPE	27. SECURITY
RADIOMETER, VISIBLE/IR SCANNING	UNC

28. APPLICATION	29. SPACECRAFT
MET, ATM-PHYS, PART-FLD	NOAA 2

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.

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32. PHENOMENA OBSERVED

ENERGY IN THE INFRARED AND VISIBLE REGION OF THE SPECTRUM

33. MEASUREMENT RANGE

VISIBLE BRIGHTNESS: 50-10,000 FT-LAMBERTS; IR TEMP:180-330 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		CONTINUOUS

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	2 NM VISIBLE, 4 NM IR 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	0.5 CU FT	14 WATTS			1 YEAR

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

FLOWN ON NOAA-1 AND ITOS-1

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
TEMPERATURE/HUMIDITY INFRARED RADIOMETER	THIR	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0007

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
MC CULLOCH, A. W.	GODDARD SPACE FLT CENTER	301-982-5042

9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
GOLDBERG, I. L.	GODDARD SPACE FLT CENTER	301-982-5042

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	OA/ERN	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
SANTA BARBARA RES.CORP.	SANTA BARBARA, CALIF.	04/70	NA

26. INSTRUMENT TYPE	27. SECURITY
RADIOMETER, 2-CHANNEL IR HIGH-RESOLUTION SCANNING	UNC

28. APPLICATION	29. SPACECRAFT
MET, ERSP	NIMBUS-4

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	SEE ITEM 31	3.15SECONDS

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

DETECTOR TEMPEMPERATURE SHALL NOT EXCEED +40 DEG C.

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

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
TEMPERATURE/HUMIDITY INFRARED RADIOMETER	THIR	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0008

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
MC CULLOCH, A. W.	GODDARD SPACE FLT CENTER	301-982-5042

9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
GOLDBERG, I. L.	GODDARD SPACE FLT CENTER	301-982-5042

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	OA/ERN	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
SANTA BARBARA RES. CORP.	SANTA BARBARA, CALIF.	12/72	NA

26. INSTRUMENT TYPE	27. SECURITY
RADIOMETER, 2-CHANNEL IR HIGH-RESOLUTION SCANNING	UNC

28. APPLICATION	29. SPACECRAFT
MET, ERSP	NIMBUS-E

30. PURPOSE

PRIMARY-TO PROVIDE NIGHT TIME AND DAY TIME INFRARED 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 AS THE HRIR IS A SCANNING RADIOMETER. THE SCAN IS ACCOMPLISHED BY A PLANE MIRROR ROTATING AT 48RPM. REFLECTIONS 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 FOR THE 11-MICRON CHANNEL. ELEVEN MICRON HAS A 0.4 DEG (7.0 MILLIRAD) FOV WHICH GIVES A 4.2 NM RESOLUTION FROM A 600 NM ORBIT. THE 6-MIVRON CHANNEL HAS A 1.2 DEG (21 MILLIRAD) FOV 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 DEG K

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
6.5 TO 12.5 MIVRONS	SEE ITEM 31	SEE ITEM 62

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. DEG		MED C IRCULAR	SUN-SYNCH HIGH NOON

46. SPECIAL REQUIREMENTS

DETECTOR TEMPEMPERATURE SHALL NOT EXCEED +40 DEG C.

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 TELEMETRY	CONTINUOUS

62. TELEMETRY REQUIREMENTS

130 HZ FOR 6.5-7.0 MICRON CHANNEL; 345 HZ FOR 10.5-12.5 MICRONS

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

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
TWO-CHANNEL RADIOMETER	TCR	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0002

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE

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
					PROPOSAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B.B.	NASA HDQTRS	OA/ERN	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
		1974	

26. INSTRUMENT TYPE	27. SECURITY
RADIOMETER, IR	UNC

28. APPLICATION	29. SPACECRAFT
MET, ERSP	NIMBUS-F

30. PURPOSE

PRIMARY-TO DETECT THERMAL RADIATION OF THE EARTH AND ATMOSPHERE ***SECONDARY-TO PRODUCE HIGH RESOLUTION INFRARED CLOUD COVER PICTURES

31. PRINCIPLES OF OPERATION

THE INSTRUMENT USES A SCANNING TWO-CHANNEL RADIOMETER TO INTERCEPT RADIATION IN LATERAL STRIPS FROM HORIZON-TO-HORIZON TO FORM CONTINUOUS HIGH RESOLUTION SCENES. THE WATER-VAPOR CHANNEL IS 6.5 TO 7.0 MICRONS AND THE CO2 CHANNEL IS 10.5 TO 12.5 MICRONS-BOTH CHANNELS WILL HAVE 24-HOUR VIEWING CAPABILITY. A COMBINATION MIRROR-TELESCOPE IMAGING SYSTEM WILL TRANSMIT EARTH AND CLOUD TOP RADIATION TO BOLOMETER DETECTORS AND WILL ALSO VIEW SPACE AND THE INSTRUMENT FRAME FOR CALIBRATION REFERENCES DURING THE SCANNING PERIOD. THE RADIOMETER EMPLOYS A 5-INCH FOLDED OPTICAL SYSTEM AND A SCANNING MIRROR COMMON TO BOTH CHANNELS. THE GROUND RESOLUTION IS EXPECTED TO BE 4.2 NAUTICAL MILES IN THE 10.5 TO 12.5 MICRON REGION AND ABOUT 12.6 NAUTICAL MILE IN THE 6.5 TO 7.0 MICRON BAND FROM ORBIT.

32. PHENOMENA OBSERVED

RADIATION FROM EARTH AND CLOUD TOPS

33. MEASUREMENT RANGE

THERMAL REGION

34. PRECISION AND ACCURACY

SEE ITEM 31

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
6.5 TO 12.5 MICRONS	SEE ITEM 31	

38. FIELD OF VIEW	39. GROUND SWATH
0.4 BY AND 1.2 DEG	4.2 & 12.6 NM HORIZON-TO-HORIZON

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
IR RADIOMETER, OPTICS & SCANNING MIRROR, DETECTORS, 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
		CONTINUOUS

62. TELEMETRY REQUIREMENTS

63. ADVANTAGES AND LIMITATIONS

64. REFERENCES
PRELIMINARY DATA SHEET FOR NIMBUS-F, NOV.1 1970

65. HISTORICAL REMARKS

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
VERTICAL TEMPERATURE PROFILE RADIOMETER	VTPR	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0001

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
R. PINAMONTI	NASA/GSFC	301-982-5042
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
GARBACZ ,M	NASA HDQTRS	OA/ERO	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
BARNES ENGINEERING	STAMFORD, CONN.	10/ 72	

26. INSTRUMENT TYPE	27. SECURITY
RADIOMETER	UNC

28. APPLICATION	29. SPACECRAFT
MET, ATM-PHYS	NOAA-2

30. PURPOSE

PRIMARY- TO OBTAIN A CONTINUOUS SERIES OF WORLD-WIDE REAL-TIME IOSTHERM MAPS AT ALTITUDES UP TO 30KM. VERTICAL TEMPERATURE PROFILES ARE DERIVED FROM RADIOMETRIC MEASUREMENTS IN EIGHT CHANNELS THROUGH MATHEMATICAL INVERSION TECHNIQUES.

31. PRINCIPLES OF OPERATION

RADIANT ENERGY IN EIGHT OPTICAL FILTER CHANNELS,6 IN THE 15 MICRON CO2 BAND, ONE IN THE 8-12 MICRON WINDOW AND ONE IN THE 18.7 MICRON H2O BAND,IS COLLECTED FROM THE 2.2° X 2.1° FIELD OF VIEW BY A CASSEGRAIN TYPE OPTICAL SYSTEM USING SPHERICAL SURFACES ON THE PRIMARY AND SECONDARY MIRRORS. THESE TWO ELEMENTS PRODUCE AN F/3 CONVERGING OPTICAL BEAM ONTO THE ROTATING FILTER WHEEL AT WHICH POINT THE FIELD DEFINING STOPS ARE SITUATED. AFTER PASSING THROUGH THIS FIELD STOP, THE ENERGY IS FOCUSED ONTO A PYROELECTRIC DETECTOR CELL BY A FIELD OPTICAL SYSTEM COMPRISED OF IRTRAN-4 FIELD LENS AND A REFLECTIVE PYRAMID OPTIC.THE DETECTOR IS SITUATED AT THE TRUNCATED OPENING OF THE REFLECTIVE PYRAMID WHICH PRODUCES AN ESSENTIALLY CIRCULAR IMAGE POLYHEDRON. THIS IMAGE POLYHEDRON EFFECTIVELY MAGNIFIES THE DETECTOR AREA AND RESULTS IN AN EFFECTIVE OPTICAL SPEED FOR THE INSTRUMENT OF F/0.6.CROSSTRACK SCANNING IS ACHIEVED THROUGH THE USE OF A STEPPER MOTOR AND CAM,WHICH IN TURN CAUSES THE SCAN MIRROR TO MOVE ABOUT AN AXIS NORMAL TO THE OPTICAL AXIS OF THE VTPR TELESCOPE.FOR IN-FLIGHT CALIBRATION,IT IS NECESSARY TO MOVE THE SCAN MIRROR ABOUT THE OPTICAL AXIS OF THE TELESCOPE.

32. PHENOMENA OBSERVED

ENERGY IN THE INFRARED REGION OF THE SPECTRUM

33. MEASUREMENT RANGE

34. PRECISION AND ACCURACY

0.6 DEG AT 300 DEG K

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
8 TO 18.7 MICRONS		0.5 SEC

38. FIELD OF VIEW	39. GROUND SWATH
2.2° BY 2.1°	

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

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
30 LB		19 WATTS			

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

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
BLACK BODY-SPACE VIEW	DELAYED TELEMETRY	CONTINUOUS

62. TELEMETRY REQUIREMENTS

63. ADVANTAGES AND LIMITATIONS

64. REFERENCES
FALBEL, G.: DESIGN AND PERFORMANCE CHARACTERISTICS OF THE VERTICAL TEMPERATURE PROFILE RADIOMETER (VTPR) FOR ATMOSPHERIC TEMPERATURE SOUNDINGS, PRESENTED 8TH REMOTE SENSING SYMPOSIUM

65. HISTORICAL REMARKS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
VERY HIGH RESOLUTION RADIOMETER	VHRR	NA

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0003

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
SHENK, W. E.	GODDARD SPACE FLT CENTER	301-982-5042
9. CO-INVESTIGATOR	**10. ORGANIZATION**	**11. TELEPHONE**
GOLDBERG, I. L.	GODDARD SPACE FLT CENTER	301-982-5042

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
			10/69		

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
BURKE, J.R.	NASA HDQTRS	OA/ECS	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
ITT INDUSTRIAL LABS	FORT WAYNE, INDIANA		27 MONTH

26. INSTRUMENT TYPE	27. SECURITY
RADIOMETER, SCANNING IR AND VISIBLE	UNC

28. APPLICATION	29. SPACECRAFT
ERSP, MET, OCEAN	ATS-F

30. PURPOSE

PRIMARY-TO OBSERVE CLOUD COVER AND CLOUD MOTION OVER A LARGE PORTION OF THE EARTH BOTH DAY AND NIGHT AND MEASURE CLOUD TOP OR EARTH'S SURFACE TEMPERATURE***SECONDARY-ESTIMATE HEIGHTS OF CLOUD TOP SURFACES THROUGH TEMPERATURE MEASUREMENTS.

31. PRINCIPLES OF OPERATION

INSTRUMENT OPERATES OVER TWO CHANNELS: 0.55 TO 0.75 MICRON AND 10.5 TO 12.5 MICRONS. INCOMING RADIATION IS REFLECTED FROM THE SCAN MIRROR AND FOCUSED BY AN 8-IN DIAMETER F/3 CASSEGRAIN TELESCOPE AT THE CHOPPER. THE CHOPPER ALTERNATELY DIRECTS INCOMING RADIATION AND BLACK BODY REFERENCE RADIATION TO THE DETECTOR. AFTER CHOPPING, CHANNEL SEPERATION IS ATTAINED VIA A REFLECTING CHOPPER. A TWO-AXES SCAN MIRROR PRODUCES A TV-TYPE PICTURE VIA A FAST SCANNING MOTION AND A LINE-BY-LINE TILTING, STEP MOTION. THE LINE SCAN OCCURS BY TURNING THE SCANNING MIRROR SO AS TO SCAN THE FIELD AT A CONSTANT ANGULAR VELOCITY. THE VISIBLE DETECTOR, A SILICON PHOTOVOLTAIC DEVICE, OPERATES INTO A LOW IMPEDANCE. THE VISIBLE CHANNEL HAS THE RESOLUTION OF THE IR CHANNEL. COVERAGE OF THE 20 X 20 DEGREE FIELD OF VIEW TAKES APPROXIMATELY 24 MINUTES. THE IR CHANNEL PRODUCES FULL EARTH PICTURES DAY AND NIGHT, AND HAS THE ADDED CAPABILITY OF TEMPERATURE MEASUREMENT FROM WHICH CLOUD HEIGHT MAY BE INFERRED USING STANDARD ATMOSPHERIC CURVES. THE VISIBLE CHANNEL ALSO PROVIDES HIGH-RESOLUTION EARTH ALBEDO MEASUREMENTS.

32. PHENOMENA OBSERVED

RADIATION FROM EARTH'S SURFACE AND CLOUD COVER

33. MEASUREMENT RANGE

0 DEG K TO 340 DEG K IN IR CHANNEL.

34. PRECISION AND ACCURACY

1.5 DEGREES K AT 200 DEGREES K, 1200 LINES PER PICTURE FRAME

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.55 TO 12.5 MICRONS	SEE ITEM 31	0.3MILSEC

38. FIELD OF VIEW	39. GROUND SWATH
20 BY 0.023DEG	8 NM AT SUBSATELLITE POINT FROM SYNCH ALT

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.023 DEG	8 NM AT SUBSATELLITE POINT FROM SYNCH ALTITUDE

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

46. SPECIAL REQUIREMENTS
DETECTOR COOLED TO 90 DEG K.

47. COMPONENTS
RADIOMETER, CASSEGRAIN TELESCOPE, DETECTOR, ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
75 LB	1.43 CU FT	20 WATTS		25 WATTS	3 YEAR

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

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
BLACKBODY REFERENCE	REALTIME TELEMETRY	EVERY 24 MINUTES

62. TELEMETRY REQUIREMENTS

450 HZ INFORMATION BANDWIDTH

63. ADVANTAGES AND LIMITATIONS

ADVANTAGE-TAKES FULL EARTH PICTURES OVER A 24 HOUR PERIOD; CAN MEASURE SURFACE TEMPERATURE IN CLOUD FREE AREAS.

64. REFERENCES

1) GOLDBERG, I. L., A VERY HIGH RESOLUTION RADIOMETRIC EXPERIMENT FOR ATS-F AND G, JAN, 1968.

65. HISTORICAL REMARKS

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
VERY HIGH RESOLUTION RADIOMETER	VHRR	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0001

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
J.O'BRIEN	GSFC	982-5042
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
CPIF	NHS 5 10306				OPERATIONAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GARBACZ, M.	NASA HDQTRS	OA/ERO	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
RCA AED	HIGHTSTOWN, N.J.	10/72	

26. INSTRUMENT TYPE	27. SECURITY
RADIOMETER	

28. APPLICATION	29. SPACECRAFT
MET	NOAA-2

30. PURPOSE

PRIMARY-TO. MEASURE EMITTED RADIATION FROM THE EARTH DURING THE DAY AND NIGHT 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(0.6-0.7 MICRONS) BOTH WITH AN INSTANTANEOUS FOV OF .6 MILLIRADIANS. THE RADIOMETER SCANS THE EARTH'S SURFACE FROM HORIZON TO HORIZON. PERPENDICULAR TO THE ORBITAL PLANE BY MEANS OF A CONTINUOUSLY ROTATING MIRROR(400RPM WHICH IS INCLINED 45° 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 INCH IN DIAMETER DALL-KIRKHAM SYSTEM,AND IS THEN FOCUSED ON TO THE BEAM SPLITTER (DICHROIC MIRROR).THE LIGHT PASSES THROUGH AND IS MEASURED BY A SOLID STATE RADIANT ENERGY DETECTOR(PHOTO DIODE).THE IR IS REFLECTED FROM THE BEAM SPLITTER AND PASSED THROUGH 10.5-12.5 MICRON WAVELENGTH FILTER ONTO A RADIATIVELY COOLED HGCDTE DETECTOR AT 105°K

32. PHENOMENA OBSERVED

ENERGY IN THE INFRARED AND VISIBLE REGION OF THE SPECTRUM

33. MEASUREMENT RANGE

VISIBLE BRIGHTNESS: 50-10,000 FT-LAMBERTS;IR TEMP:180-330°K

34. PRECISION AND ACCURACY

1.0 K DEG AT 300 DEGK: 3K DEG AT 185 DEG K

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
.6-.7 MICRONS 10.5-12.5MICRONS		

38. FIELD OF VIEW	39. GROUND SWATH
.6 MILLIRADIANS	150 DEGREES LIMB TO LIMB(SAME AS SR)

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
.6 MR	.6 MR

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		790 NM	102°

46. SPECIAL REQUIREMENTS

47. COMPONENTS
2 RADIOMETERS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
21 LB.		7W EACH			1 YEAR

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

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

62. TELEMETRY REQUIREMENTS
VIDEO BANDWIDTH 35 KHZ

63. ADVANTAGES AND LIMITATIONS
1ST OPERATIONAL IR DETECTOR COOLED TO 105°K

64. REFERENCES

65. HISTORICAL REMARKS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
VISIBLE/INFRARED SPIN-SCAN RADIOMETER	VISSR	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0002

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
FORDYCE, D. V.	GODDARD SPACE FLT CENTER	301-982-5042

9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
WEINREB, M. B.	GODDARD SPACE FLT CENTER	301-982-5042

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

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
GARBACZ, M.L.	NASA HDQTRS	OA/ERO	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
SANTA BARBARA RES.CENTER	GOLETA, CALIF.	12/72	

26. INSTRUMENT TYPE	27. SECURITY
RADIOMETER	UNC

28. APPLICATION	29. SPACECRAFT
MET	SMS-A

30. PURPOSE

PRIMARY-TO PROVIDE HIGH RESOLUTION SPIN SCAN PICTURES OF THE EARTH IN TWO SPECTRAL REGIONS (0.55-0.70 MICRONS AND 10.5-12.6 MICRONS).

31. PRINCIPLES OF OPERATION

THE SCANNER DESIGN USES A PLANE SCAN MIRROR AND PRIMARY OPTICS WHICH ARE COMMON TO THE VISIBLE AND THERMAL CHANNELS. THE SCAN MIRROR IS SET AT AN ANGLE TO THE RADIOMETER TELESCOPE (PRIMARY OPICS) AXIS WHICH IS ALIGNED PARALLEL TO THE SPIN AXIS OF THE SPACECRAFT. THE SPINNING MOTION OF THE SPACECRAFT, THEREFORE, PROVIDES AN EAST-WEST LINE SCAN MOTION WHEN THE SPIN AXIS OF THE SPACECRAFT IS ORIENTED PARALLEL WITH THE EARTH'S AXIS. RADIATION COLLECTED BY THE PRIMARY OPTICS IS IMAGED IN A PLANE BETWEEN THE PRIMARY AND SECONDARY MIRRORS. AT THIS POINT, THE VISIBLE AND THERMAL CHANNELS ARE OPTICALLY SEPERATED. FIBER OPTICS LIGHT-GUIDES ARE THE DEFINING FIELD STOP APERTURE FOR THE 8 VISIBLE CHANNELS. RADIATION INTERCEPTED BY EACH OF THE FIBER OPTIC LIGHT-GUIDES IS COLLIMATED BY A SPHERICAL LENS AND THEN FILTERED. FOLLOWING FILTERING, THE COLLIMATED RADIATION IN EACH VISIBLE CHANNEL IS DIRECTED INTO A PHOTOMULTIPLIER TUBE HAVING AN S-20 RESPONSE. RADIATION FOR THE THERMAL CHANNEL IS RE-IMAGED BY MEANS OF A RELAY LENS ONTO AN INTRINSIC LONG WAVELENGTH DETECTOR. A 10.5 TO 12.6 MICRON BANDPASS FILTER IS LOCATED IN THE CONVERGING BEAM OF THE RELAY LENS SYSTEM AND ESTABLISHES THE SPECTRAL BAND LIMITS FOR THE THERMAL CHANNEL.

32. PHENOMENA OBSERVED

REFLECTED AND THERMAL RADIATION FROM EARTH'S SURFACE

33. MEASUREMENT RANGE

VISIBLE AND INFRARED SPECTRAL REGIONS

34. PRECISION AND ACCURACY

SIGNAL DYNAMIC RANGE: 44 DB-VISIBLE; 27-DB IR

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.55 TO 12.6 MICRONS	SEE ITEM 30	40 MIN

38. FIELD OF VIEW	39. GROUND SWATH

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
	0.5 NM VISIBLE BANDS; 5 NM THERMAL BAND

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

46. SPECIAL REQUIREMENTS

CRYOGENIC COLLING

47. COMPONENTS

PRIMARY OPICS, FIBER & RELAY OPTICS, FILTERS, DETECTORS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
133 LB	13.7 CU FT	23 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
BLACKBODY, SUN & SPACE	DELAYED TELEMETRY	CONTINUOUSLY

62. TELEMETRY REQUIREMENTS

INFORMATION BANDWIDTH: 225 KHZ VISIBLE CHANNELS; 30 KHZ THERMAL

63. ADVANTAGES AND LIMITATIONS

UNIQUE RADIATION COOLER MAKES POSSIBLE COOLING OF IR DECTECTORS FOR LONG DURATION SPACE MISSIONS.

64. REFERENCES

1)STEPHEN, A.A., ET.AL., DATA FLOW IN THE SYNCHRONOUS METEOROLOGICAL SATELLITE SYSTEM. 2) TECHNICAL PROPOSAL NO. SM6-69: VISIBLE INFRARED SPIN-SCAN RADIOMETER (VISSR) FOR A SYNCHRONOUS METEOROLOGICAL SPACECRAFT, SANTA BARBARA RESCARCH CENTER.

65. HISTORICAL REMARKS

SPECTROMETERS

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INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
BACKSCATTERED ULTRAVIOLET RADIATION EXPERIMENT	BUV	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0008

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
HEATH, DR. D.F.	GODDARD SPACE FLT CENTER	301-982-5042

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
					OPERATIONAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B.B.	NASA HDQTRS	OA/ERN	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
BECKMAN INST. CORP.	FULLERTON, CALIF.	04/70	NA

26. INSTRUMENT TYPE	27. SECURITY
SPECTROMETER, EBERT-TYPE GRATING ULTRAVIOLET PHOTOMETRIC	UNC

28. APPLICATION	29. SPACECRAFT
MET	NIMBUS-4

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 3600 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 SO THAT THE INTENSITY OF 12 OZONE ABSORPTION BANDS ARE MONITORED 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 4200 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 MICROAMPS AT 2550 A. A MEASUREMENT SUB-CYCLE TAKES 32 SECS. THERE ARE 192 SUB-CYCLES OR FRAMES INCLUDING 26 CALIBRATION FRAMES. 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	10 A	32 SEC

38. FIELD OF VIEW	39. GROUND SWATH
13. DEG	135 NM DIAM CIRCLE FROM 600 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
12. DEG	126 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; COMPLETE CYCLE OF 192 FREQUENCY SAMPLES TAXES 6144 SECONDS.

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

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
FILTER-WEDGE SPECTROMETER	FWS	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0006

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
HOVIS, DR. W. A.	GODDARD SPACE FLT CENTER	301-982-5042

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	OA/ERN	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
ITT INDUSTRIAL LABS.	FORT WAYNE, INDIANA	04/70	NA

26. INSTRUMENT TYPE	27. SECURITY
SPECTROMETER, CIRCULAR-WEDGE INTERFERENCE-FILTER INFRARED	UNC

28. APPLICATION	29. SPACECRAFT
MET	NIMBUS-4

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

REFLECTIVE AND THERMAL IR REGIONS

34. PRECISION AND ACCURACY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
1.2 TO 6.4 MICRONS	2.3 PERCENT	16. SECONDS

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

REFERENCE BLACK BODY MAINTAINED AT 300 DEG K

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

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
INFRARED INTERFEROMETER/SPECTROMETER	IRIS	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
HANEL, R.A.	GODDARD SPACE FLT CENTER	301-982-5042
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	OA/ERN	202-755-2322

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 EQUALTIONS.

32. PHENOMENA OBSERVED

EMISSION FROM THE EARTH FROM 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 MILSEC

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

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
INFRARED INTERFEROMETER/SPECTROMETER	IRIS	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0008

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
HANEL, R. A.	GODDARD SPACE FLT CENTER	301-982-5042

9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
CONRATH, DR. B.	GODDARD SPACE FLT CENTER	301-982-5042

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	OA/ERN	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
TEXAS INSTRUMENTS	DALLAS, TEXAS	04/70	NA

26. INSTRUMENT TYPE	27. SECURITY
SPECTROMETER, MODIFIED MICHELSON INFRARED INTERFEROMETER	UNC

28. APPLICATION	29. SPACECRAFT
MET	NIMBUS-4

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 COMDITIONS APPROPRIATE SPECTRAL ABSORPTION REGIONS MUST BE CHOSEN AND EMPLOYED IN AN INVERSION OF THE RADIATIVE TRANSFER EQUATIONS.

32. PHENOMENA OBSERVED

EMITTED IR ENERGY FROM EARTH AND ITS ATMOSPHERE

33. MEASUREMENT RANGE

THERMAL IR ENERGY

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	16. SECONDS

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

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
INFRARED SPECTROMETER: EARTH RESOURCES EXPERIMENT	IRS	S-191
(TITLE CONT.)	4. RESUME DATE	5. VERSION
PACKAGE (EREP)	09/01/72	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
BARNET, T. L.	MANNED SPACECRAFT CENTER	713-483-0123
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
					ENG. MODEL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
FISCHETTI, T.L.	NASA HDQTRS	OA/ERS	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
BLOCK ENGINEERING CO.		1973	

26. INSTRUMENT TYPE	27. SECURITY
SPECTROMETER	UNC

28. APPLICATION	29. SPACECRAFT
ERSP	SKYLAB-A

30. PURPOSE

PRIMARY-TO PERFORM CONTROLLED EXPERIMENTS TO DETERMINE SUITABILITY OF NEAR AND THERMAL IR REGIONS FOR EARTH RESOURCES SENSING FROM ORBITAL ALTITUDES***SECONDARY-TO QUANTITATIVELY EVALUATE EFFECTS OF ATMOSPHERIC ATTENUATION ON RADIATION FROM GROUND TARGETS.

31. PRINCIPLES OF OPERATION

THE SPECTROMETER IS OF FILTERWHEEL DESIGN, UTILIZING TWO CONTINUOUSLY VARIABLE INTERFERENCE FILTERWHEELS COVERING THE RANGES .4 TO 2.4 MICRONS AND 6.2 TO 15.5 MICRONS. SPECTRAL RESOLUTION IS 1% TO 4% IN WAVELENGTH, WITH A SCAN RATE OF ONE SCAN PER SECOND THROUGH THIS REGION. THE OPTICAL SYSTEM UTILIZES A 10-INCH CASSEGRAIN PRIMARY, AND HAS A FOV OR SPATIAL RESOLUTION OF 1 MRAD. AT LEAST TWO DETECTORS ARE REQUIRED TO COVER THE SPECTRAL REGIONS. COOLING TO 77 DEG K REQUIRED BY THE HG-CD-TI THERMAL DETECTOR IS ACCOMPLISHED WITH A SOLID CRYOGEN. SI, GA-AS, PB-SE, IN-AS, AND PB-S ARE CANDIDATE SHORT WAVELENGTH DETECTORS. SYSTEM SENSITIVITIES ARE +-0.1 DEG K NET IN THERMAL REGION (300 DEG K TARGET AND BACKGROUND, NO ATMOSPHERE) AND +-0.1% NET IN THE REFLECTIVE REGION (SOLAR RADIANCE AT EARTH, NO ATMOSPHERE). INFLIGHT CALIBRATION IS ACHIEVED WITH TWO BLACKBODY SOURCES KNOWN TO +.1 DEG K AND ONE SHORT WAVELENGTH SOURCE OF RADIANCE KNOWN TO +.1%. BY COMPARING DATA COLLECTED FROM THE SPECTROMETER WITH DATA TAKEN SIMULTANEOUSLY ON THE GROUND AND FROM AIRCRAFT, INVESTIGATORS WILL BE ABLE TO ASSES THEIR REQUIREMENTS REGUARDING IR SENSOR CAPABILITY, SENSITIVITY, SPECTRAL RESOLUTION, AND EVALUATE THE UTILITY OF REMOTE SENSING FROM SPACE.

32. PHENOMENA OBSERVED

REFLECTED AND THERMAL RADIATION FROM EARTH

33. MEASUREMENT RANGE

VISIBLE, NEAR IR, AND THERMAL WAVELENGHTS

34. PRECISION AND ACCURACY

8% ABSOLUTE IN 0.4-2.4 MICRON REGION, 72% BEYOND.

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
0.4 TO 15.5 MICRONS	SEE ITEM 31	1.0 SEC

38. FIELD OF VIEW	39. GROUND SWATH
0.05 DEG	SEE * IN REFERENCE BELOW

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.057 DEG	SEE ** IN HISTORICAL REMARKS

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
**		235 NM	50 DEG

46. SPECIAL REQUIREMENTS

WINDOWS FOR INCOMING RADIATION MUST HAVE TRANSMITTANCE OF 0.9

47. COMPONENTS

COLLECTING OPTICS, FILTERWHEEL, DETECTORS, FILM AND MAGNETIC TAPE

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
300 LB	11.2 CU FT	200 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	FROM FILM AND TAPE	FLEXIBLE

62. TELEMETRY REQUIREMENTS

63. ADVANTAGES AND LIMITATIONS

DATA ACQUISITION LIMITED TO CLOUD-FREE REGIONS.

64. REFERENCES

EXPERIMENT IMPLEMENTATION PLAN FOR MANNED SPACEFLIGHT EXPERIMENTS-TITLE: INFRARED SPECTROMETER
EARTH RESOURCES REMOTE SENSING SYSTEMS, MSC-P6-0406
* MANUAL TARGET TRACKING WITH VIEWFINDER/TRACKING SYSTEM. V/TS LOOK ANGLE 45 DEG. AHEAD, 10 DEG. BEHIND, AND 20 DEG.EITHER SIDE OF NADIR. 235 NM ORBIT.

65. HISTORICAL REMARKS

** PRED. MANUAL ACQUISITION OF 0.25 NM WITHIN A 1 NM CIRCLE

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
METEROLOGICAL INFRARED SPECTROMETER	MIRS	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
8-CHANNEL	09/01/72	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
WARK, DR. D.Q.	NAT ENV SAT CTR, NOAA	301-735-2000
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
HILLEARY, D.T.	NAT ENV SAT CTR, NOAA	301-735-2000

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	OA/ERN	202-755-2322

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

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
MAPPING MICROWAVE SPECTROMETER	MMS	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0002

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
STAELIN, D. H.	MASS. INST. OF TECH.	617-864-6900
9. CO-INVESTIGATOR	**10. ORGANIZATION**	**11. TELEPHONE**
BARATH, F. T.	JET PROPULSION LABS.	213-354-4321

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

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B.B.	NASA HDQTRS	OA/ERN	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
		1974	

26. INSTRUMENT TYPE	27. SECURITY
SPECTROMETER, MICROWAVE RADIOMETER	UNC

28. APPLICATION	29. SPACECRAFT
MET	NIMBUS-F

30. PURPOSE

PRIMARY-TO MAP TROPOSPHERIC TEMPERATURE PROFILES, WATER VAPOR ABUNDANCE, AND CLOUD WATER CONTENT.

31. PRINCIPLES OF OPERATION

THE INSTRUMENT IS A 5-CHANNEL MICROWAVE RADIOMETER, EACH OF THE DICKE SUPERHETERODYNE TYPE UTILIZING ALL SOLID STATE COMPONENTS. THE INSTRUMENT WILL MAP THERMAL RADIATION AT 5 WAVELENGTHS NEAR THE 5-MM OXYGEN AND 13.5-MM WATER VAPOR RESONANCES: 22.23, 31.4, 53.3, 53.85, AND 54.9 GHZ. BANDWIDTH ON ALL CHANNELS IS 200MHZ. EACH WAVELENGTH IS AFFECTED TO A DIFFERENT DEGREE BY THE TERRESTRIAL SURFACE, CLOUDS, PRECIPITATION, WATER VAPOR AND TEMPERATURE PROFILE. BY APPROXIMATELY INTERPRETING A SET OF SIMULTANEOUS EQUATIONS, MOST OF THE PARAMETERS CAN BE ESTIMATED SEPARATELY. TRUE TEMPERATURE PROFILES WILL BE INFERRED TO WITHIN 2 OR 3 DEG K AND WILL BE UNAFFECTED BY CIRRUS CLOUDS OR CLOUDS WITH LESS THAN 0.05-G/CU CM LIQUID WATER CONTENT. THE TWO CHANNELS NEAR 1-CM WAVELENGTH PERMIT WATER VAPOR CLOUD WATER CONTENT OVER CALM OCEAN TO BE ESTIMATED SEPARATELY. THE DYNAMIC RANGE FOR ALL CHANNELS WILL BE FROM 0 TO 400 DEG K WITH +-0.1% LINEARITY. SENSITIVITY OF THE OXYGEN RADIOMETERS WILL BE BETTER THAN 1 DEG K RMS AND THAT OF THE H2O RADIOMETERS BETTER THAN 0.5 DEG K RMS, ALL WITH A 2**2 SECOND INTEGRATION TIME. THE ABSOLUTE ACCURACY OF ALL RADIOMETERS WILL BE BETTER THAN 2 DEG K RMS, LONG TERM.

32. PHENOMENA OBSERVED

THERMAL RADIATION FROM EARTH, ATMOSPHERE, AND CLOUDS

33. MEASUREMENT RANGE

OXYGEN AND WATER VAPOR RESONANCE LINES

34. PRECISION AND ACCURACY

SEE ITEM 31

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
5.47 TO 13.5 MM	SEE ITEM 31	SEE ITEM 31

38. FIELD OF VIEW	39. GROUND SWATH
10 BY 10 DEG	100 NM BY 1200 NM FROM 600 NM ALTITUDE

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
10 DEG	100 NM

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

46. SPECIAL REQUIREMENTS

47. COMPONENTS
RADIOMETERS, SCANNING HORNS, CALIBRATION PLATES

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
70 LB	1.5 CU FT	40 WATTS			

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

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

62. TELEMETRY REQUIREMENTS

63. ADVANTAGES AND LIMITATIONS

64. REFERENCES
PRELIMINARY DATA SHEET FOR NIMBUS-F, NOV., 1970.

65. HISTORICAL REMARKS

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
MONITOR OF ULTRAVIOLET SOLAR ENERGY	MUSE	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0007

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
HEATH, DR. D. F.	GODDARD SPACE FLT CENTER	301-982-5042

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	OA/ERN	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
ADCOLE CORPORATION	WALTHAM, MASS.	04/70	NA

26. INSTRUMENT TYPE	27. SECURITY
SPECTROMETER, 6-CHANNEL OPTICAL-FILTER PHOTODIODE	UNC

28. APPLICATION	29. SPACECRAFT
MET, ATM-PHYS	NIMBUS-4

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 IS SIMILAR TO THE ONE FLOWN ON NIMBUS-2 BUT WITH MINOR VARIATIONS. THE ULTRAVIOLET SENSORS CONSIST OF FIVE PHOTODIODES WHOSE SHORT WAVELENGTH RESPONSE IS DETERMINED BY SUITABLE OPTICAL FILTERS, WHILE THE LONG WAVELENGTH CUTOFF IS DETERMINED BY VARYING DEGREES OF 'SOLAR BLINDNESS' OF DIFFERENT PHOTOCATHODE MATERIALS. THE FIVE CHANNELS HAVE RESPONSES TO RADIATION IN THE FOLLOWING RANGES: 1300 - 1600 A, 1750-1850A, 2750-3150A, 2050-2150A, AND 2760-2860A. 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 90 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
1300. TO 3150. A	100. A	48. SECONDS

38. FIELD OF VIEW	39. GROUND SWATH
90. DEG	850 NM FROM 600 NM ORBIT

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

TEMPERATURE MUST BE MAINTAINED BETWEEN 0 AND 55 DEG C.

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. TEMPERATURE MUST BE MAINTAINED BETWEEN 5 AND 40 DEGREES C .
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

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
POSITIVE ION COMPOSITION SPECTROMETER	PICS	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0002

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
TAYLOR, H. A., JR.	GODDARD SPACE FLT CENTER	301-982-5042

9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
BRINTON, H. C.	GODDARD SPACE FLT CENTER	301-982-5042

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

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B.B.	NASA HDQTRS	OA/ERN	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
		1974	

26. INSTRUMENT TYPE	27. SECURITY
MASS SPECTROMETER	UNC

28. APPLICATION	29. SPACECRAFT
IONOSPHERE AND RADIO PHYSICS	NIMBUS-F

30. PURPOSE

PRIMARY-TO DETERMINE THE GLOBAL DISTRIBUTION OF UPPER ATMOSPHERE ION COMPOSITION WITH EMPHASIS ON 'SOLAR-GEOMAGNETIC' SEASONAL VARIATIONS WHICH MAY REVEAL A LINK BETWEEN ENERGETIC PROCESSES ACTIVE IN BOTH UPPER AND LOWER ATMOSPHERE REGIONS.

31. PRINCIPLES OF OPERATION

AMBIENT, THERMAL, POSITIVE IONS ARE SAMPLED IN SITU BY THE BENNETT RF MASS SPECTROMETER SENSOR WITH ORIFICE ORIENTED INTO DIRECTION OF MOTION. INSTRUMENT MEASURES DIRECTLY ALL IONS PRESENT IN THE MASS RANGE 1-36 ATOMIC MASS UNITS (AMU), INCLUDING ALL PRINCIPAL IONS ANTICIPATED AT THE NIMBUS ALTITUDE. COMPLETE MASS RANGE IS 'SWEPT' OR SAMPLED ONCE EVERY 18 SECONDS, IN A CONTINUING CYCLE. ION CURRENTS COLLECTED ARE RELATED TO EQUIVALENT AMBIENT ION CONCENTRATIONS AT THE SENSOR ORIFICE. THE INSTRUMENT HAS AN ION CURRENT SENSITIVITY OF 5X10**-14 TO 5X10**-9 AMPERES WHICH IS EQUIVALENT TO AN ION CONCENTRATION SENSITIVITY OF 10 TO 10**6 IONS/CC. EACH ATOMIC MASS UNIT POSITION IS SAMPLED ONCE EVERY 16 SECONDS, CORRESPONDING TO A SPATIAL RESOLUTION OF APPROXIMATELY 100 KILOMETERS AND 1 DEG OF LATITUDE.

32. PHENOMENA OBSERVED

POSITIVELY CHARGED THERMAL IONS INCLUDING HT, OT, HET, AND NT

33. MEASUREMENT RANGE

34. PRECISION AND ACCURACY

SEE ITEM 31

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
		18 SEC

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

47. COMPONENTS
BENNET SPECTROMETER TUBE, ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
	0.23 CU FT	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
		CONTINUOUS

62. TELEMETRY REQUIREMENTS

63. ADVANTAGES AND LIMITATIONS

64. REFERENCES
PRELIMINARY DATA SHEET FOR NIMBUS-F, NOV., 1970.

65. HISTORICAL REMARKS

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
SATELLITE INFRARED SPECTROMETER	SIRS	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0008

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
WARK, DR. D.Q.	NOAA/NESC	301-735-2000
9. CO-INVESTIGATOR	**10. ORGANIZATION**	**11. TELEPHONE**
HILLEARY, D.T.	NOAA/NESC	301-735-2000

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	OA/ERN	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
GULTON INDUSTRIES	ALBAQUERQUE, N.MEXICO	04/70	NA

26. INSTRUMENT TYPE	27. SECURITY
SPECTROMETER, 14-CHANNEL IR FASTIE-EBERT FIXED-GRATING	UNC

28. APPLICATION	29. SPACECRAFT
MET	NIMBUS-4

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, 23.59, 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
11.0 TO 36.0 MICRONS	0.2 MICRON	16 SEC

38. FIELD OF VIEW	39. GROUND SWATH
75.6 BY 12.5 DEG	930 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. MTBF
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 (PRELIM), 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

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
ULTRAVIOLET SOLAR-RADIATION EXPERIMENT	UVSR	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
HEATH, DR. D.F.	GODDARD SPACE FLT CENTER	301-982-5042
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	OA/ERN	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
ADCOLE CORPORATION	WALTHAM, MASS	04/69	NA

26. INSTRUMENT TYPE	27. SECURITY
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 RADIOATION 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 OVERY 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 SUB-SYSTEMS. GENERAL ELECTRIC CO. PHILADELPHIA, PA. AUG. 1967.

65. HISTORICAL REMARKS

TECHNOLOGY EXPERIMENTS

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INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
C-BAND PASSIVE REFLECTOR	CPAR	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
VEN ATTA ARRAY	09/01/72	0004

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	OA/ECD	202-755-2322

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

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
NIMBUS-E/ATS-F AND DATA ACQUISITION FACILITY	DAFDRL	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
DATA RELAY LINK	09/01/72	0002

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
COTE, C. E.	GODDARD SPACE FLT CENTER	301-982-5042
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
HEFFERNAN, P.	GODDARD SPACE FLT CENTER	301-982-5042

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

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B.B.	NASA HDQTRS	OA/ERN	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
		1974	

26. INSTRUMENT TYPE	27. SECURITY
TRANSCEIVER	UNC

28. APPLICATION	29. SPACECRAFT	
MET, ERSP, COMM.	NIMBUS-F	N

30. PURPOSE

PRIMARY-TO ESTABLISH A TWO-WAY REAL-TIME DATA RELAY LINK BETWEEN NIMBUS-E AND ATS-F TO DEMONSTRATE THE FEASIBILITY OF ELIMINATING LARGE ON-BOARD STORAGE DEVICES FOR FUTURE SPACECRAFT; FEASIBILITY OF A RELAY SATELLITE COMMAND LINK; AND FEASIBILITY OF EARTH-ORBITING SATELLITE TRACKING FROM SYNCHRONOUS SATELLITE***SECONDARY-PROVIDE INCREASED FLEXIBILTY FOR NIMBUS-E EXPERIMENTS.

31. PRINCIPLES OF OPERATION

THE ESSENTIAL ELEMENTS OF THE EXPERIMENTS ARE (1) AN ATS DATA ACQUISITION FACILITY, (2) THE ATS-F SYNCHRONOUS SATELLITE OPERATING AS A REPEATER RELAY, AND (3) THE NIMBUS-E EARTH-ORBITING SATELLITE. AN ADDITIONAL ASPECT IS THAT THE REPEATER ON NIMBUS WILL PERMIT DATA ACQUISITION AND RANGE-RATE MEASUREMENTS DIRECTLY BY ANY SPACE TRACKING AND DATA ACQUISITION NETWORK STATION EQUIPPED WITH THE GODDARD RANGE AND RANGE-RATE SYSTEM WHICH IS IN RADIO VIEW OF NIMBUS. THREE SEPARATE FUNCTIONS WHICH CAN BE PERFORMED OVER THE DATA ACQUISITION/ATS/NIMBUS LINK ARE (1) REAL-TIME TRANSMISSION FROM NIMBUS-E TO ATS-F TO THE DATA ACQUISITION FACILITY, (2) SIMULTANEOUS OR DEPENDENT RANGE AND RANGE-RATE TRACKING OF NIMBUS-E BY THE DATA ACQUISITION FACILITY THROUGH ATS-F TO NIMBUS-E AND RETURNING TO THE DATA ACQUISITION FACILITY, AND (3) REAL-TIME NIMBUS-E COMMAND OVER A UHF LINK THROUGH ATS-F.

32. PHENOMENA OBSERVED

RADIO TRANSMISSION

33. MEASUREMENT RANGE

S-BAND RADIO FREQUENCY

34. PRECISION AND ACCURACY

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
		MED-CIRCULAR	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS
AMPLIFIERS, MULTIPLEXER, ANTENNAS,

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

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

62. TELEMETRY REQUIREMENTS

63. ADVANTAGES AND LIMITATIONS

64. REFERENCES
PRELIMINARY DATA SHEET FOR NIMBUS-F, NOV., 1970.

65. HISTORICAL REMARKS

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
DATA-RELAY LINK EXPERIMENT	DAREL	E28
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
COTE, CHARLES	GODDARD SPACE FLT CENTER	301-982-5042
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
HEFFERNAN, PAUL	GODDARD SPACE FLT CENTER	301-982-5042

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.B.	NASA HDQTRS	OA/ERN	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
GODDARD SPACE FLT CENTER	GREENBELT, MARYLAND	12/72	

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 GHZ	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

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP. NO
ELECTROSTATIC PROBE	EP	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0002

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
BRACE, L. H.	GODDARD SPACE FLT CENTER	301-982-5042
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
FINDLAY, J. A.	GODDARD SPACE FLT CENTER	301-982-5042

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

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B.B.	NASA HDQTRS	OA/ERN	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
		1974	

26. INSTRUMENT TYPE	27. SECURITY
ELECTROSTATIC PROBE	UNC

28. APPLICATION	29. SPACECRAFT
IONOSPHERE AND RADIO PHYSICS	NIMBUS-F

30. PURPOSE

PRIMARY-TO MEASURE THE GLOBAL DISTRIBUTION OF ELECTRON TEMPERATURE AND CONCENTRATION AND TO COMBINE THESE WITH THE ION COMPOSITION MEASUREMENTS ON NIMBUS-F TO STUDY ATMOSPHERIC PROCESSES SUCH AS GLOBAL WIND SYSTEM AT HIGH ALTITUDES.

31. PRINCIPLES OF OPERATION

THE EXPERIMENT EMPLOYS TWO CYLINDBICAL METAL SENSORS 18 INCHES IN LENGTH. EACH SENSOR IS COMPOSED OF A 9 INCH LONG WIRE COLLECTOR THAT PROTRUDES FROM A 9 INCH LONG GUARD ELECTRODE THAT IS 0.067 INCHES IN DIAMETER. THE TWO SENSORS ARE LARGELY REDUNDANT AND ARE MOUNTED ON GENERALLY FORWARD-LOOKING SURFACES OF THE SATELLITE SO THAT THEY PROTRUDE INTO THE UNPERTURBED PLASMA JUST AHEAD OF THE SATELLITE. A SAWTOOTH VOLTAGE WAVEFORM (TYPICALLY -3 TO +5 VOLTS, 1 CPS) THAT IS APPLIED TO THE COLLECTOR CAUSES VARIATIONS IN THE PLASMA CURRENTS THAT FLOW TO THE PROBE. THE AMPLITUDE OF THESE CURRENTS IS A MEASURE OF THE ELECTRON CONCENTRATION IN THE VICINITY OF THE SATELLITE, WHILE THE CURVATURE OF THE CURRENT WAVEFORM DEPENDS UPON THE ELECTRON TEMPERATURE. THE ANALYSIS OF THE DATA IS CARRIED OUT AUTOMATICALLY BY SUITABLE CIRCUITRY WITHIN THE INSTRUMENT COMPUTER ANALYSIS OF THE RAW DATA CAN ALSO BE CARRIED OUT ON THE GROUND TO VERIFY PROPER OPERATION OF THE IN-FLIGHT ANALYSIS. THE INSTRUMENT IS EXPECTED TO RESOLVE THE ELECTRON CONCENTRATION AND TEMPERATURE THROUGHOUT THE ENTIRE ORBIT OF NIMBUS.

32. PHENOMENA OBSERVED

HIGH ALTITUDE ELECTRON ENERGIES AND DISTRIBUTIONS

33. MEASUREMENT RANGE

34. PRECISION AND ACCURACY

E

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

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

47. COMPONENTS

COLLECTOR, DETECTOR, ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
3 LB	0.04 CU FT	3 WATTS			

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

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

62. TELEMETRY REQUIREMENTS

63. ADVANTAGES AND LIMITATIONS

64. REFERENCES

PRELIMINARY DATA SHEET FOR NIMBUS-F, NOV., 1970.

65. HISTORICAL REMARKS

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
ELECTRON TEMPERATURE PROBE	ETP	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
SPENCER, N.W.	GODDARD SPACE FLT CENTER	301-982-5042

9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
BRACE, L.H.	GODDARD SPACE FLT CENTER	301-982-5042

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
TEPPER, M.	NASA HDQTRS	OA/ERD	202-755-2322

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.

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
FLUXGATE MAGNETOMETER	FMAG	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0004

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	OA/ECS	202-755-2322

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

26. INSTRUMENT TYPE	27. SECURITY
MAGNETOMETER, BIAXIAL CLOSED LOOP FLUXGATE	UNC

28. APPLICATION	29. SPACECRAFT
ATM-PHYS	ATS 1

30. PURPOSE

PRIMARY - TO MEASURE THE MAGNETIC FIELD SURROUNDING THE SPACE-CRAFT, 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 ASSOCI-ATED 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 PROPOR-TIONAL 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 SIG-NAL 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 SEN-SITIVITY 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 AC-CURACY 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. SPATIAL RESOLUTION
NA	NA

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

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

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
MILLIMETER WAVE PROPAGATION/COMMUNICATION	MWPC	NA
(TITLE CONT.)	**4. RESUME DATE**	**5. VERSION**
EXPERIMENT.	09/01/72	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
IPPOLITO, L.T.	GODDARD SPACE FLT CENTER	301-982/5042
9. CO-INVESTIGATOR	**10. ORGANIZATION**	**11. TELEPHONE**
THOMPSON, B.	HUGHES AIRCRAFT COMPANY	

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

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
BURKE, J.R.	NASA HDQTRS	OA/ECS	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME

26. INSTRUMENT TYPE	27. SECURITY
TRANSMITTERS 20 GHZ AND 30 GHZ, 2.5 WATT TWT TYPES	UNC

28. APPLICATION	29. SPACECRAFT
COMM	ATS-F

30. PURPOSE

PRIMARY-TO ASSESS THE POSSIBILITIES OF EARTH/SPACE COMMUNICATIONS IN THE KU AND KA BANDS BY DETERMINING ATMOSPHERIC PROPAGATION CHARACTERISTICS (ABSORPTION, DISPERSION, FADING, REFRACTION, AND COHERENT BANDWIDTH) OF THE BANDS UNDER VARYING WEATHER CONDITIONS.

31. PRINCIPLES OF OPERATION

THE EXPERIMENT CONSISTS OF TRANSMITTING FROM THE SPACECRAFT AT 20 GHZ AND 30 GHZ AND RECEIVING AT VARIOUS GROUND STATIONS THROUGHOUT THE U.S. IN PROPAGATION TESTS EITHER AN UNMODULATED CARRIER OR A CARRIER MODULATED BY NINE EQUAL AMPLITUDE TONES OF 1.5 GHZ BANDWIDTH CAN BE SENT. THE FORMER WILL BE USED TO DETERMINE MOST CHARACTERISTICS (SEE ITEM 30) WHILE THE LATTER WILL BE USED TO DETERMINE THE COHERENT BANDWIDTH. MEASUREMENTS OF THE AMPLITUDE AND PHASE OF THE RECEIVED SIGNALS WILL BE MADE AT GROUND STATIONS AND FORWARDED ALONG WITH WEATHER DATA TO GSFC FOR DETAILED ANALYSIS OF THE EFFECT OF ADVERSE WEATHER CONDITION ON THE PROPOGATION CHANNELS.SITE & SPATIAL DIVERSITY WILL BE OBTAINED BY UTILIZING TWO OR MORE RECEIVING STATIONS ON A SINGLE BASE LINE. COMMUNICATIONS TESTS ARE MADE BY MODULATING THE TWO DOWN LINKS EITHER SEPERATELY OR SIMULTANEOUSLY WITH SIGNALS TRANSMITTED TO THE SATELLITE ON THE 6 GHZ LINK. TYPICAL MODULATIONS INCLUDE ANALOG FM SIGNALS OF SLOW SCAN TV WITH 30 MHZ RF BANDWIDTH AND MULTICHANNEL VOICE TELEPHONY, AS WELL AS DIGITAL PCM IN BOTH THE NONCOHERENT PCM/FSK/PM MODE AND THE COHERENT PCM/-PSK/PM MODE.THE WELL-DEFINED SATELLITE 4 GHZ DOWN LINK CAN BE USED SIMULTANEOUSLY FOR CALIBRATION.

32. PHENOMENA OBSERVED

PROPAGATION CHARACTERISTICS THRU ATMOSPHERE AT 20 AND 30 GHZ.

33. MEASUREMENT RANGE

34. PRECISION AND ACCURACY

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

38. FIELD OF VIEW	39. GROUND SWATH
6. BY 9. DEG	LIMB-TO-LIMB

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
2 CIRC/DEG	N/A

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
N/A	N/A	GEOSYNC	0 DEG

46. SPECIAL REQUIREMENTS

OSCILLATOR STABILITY OF 1 PART IN 10 TO THE NINTH PER DAY

47. COMPONENTS

TRANSPONDER, HORN & DISH ANTENNAS,STABLE CRYSTAL OSCILLATOR.

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
85 LB	3. CU FT			125 WATTS	2 YEAR

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

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
SEE ITEM 31	REALTIME	MANY HOURS/DAY

62. TELEMETRY REQUIREMENTS

RF TRANSMITTER POWERS, FREQUENCY UP CONVERTER'S CURRENTS, TWT TEMPERATURES.

63. ADVANTAGES AND LIMITATIONS

64. REFERENCES

1) A PROPOSAL FOR ATS-F MILLIMETER WAVE PROPAGATION/COMMUNICATION EXPERIMENT, NASA/GSFC, AUGUST 21,1968.

65. HISTORICAL REMARKS

ATS-5 MWPC USES MANY OF THE SAME GROUND STATIONS.

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
S-BAND SATELLITE TO SATELLITE TRACKING	SBAND	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0001

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
BERBERT, J.	GODDARD SPACE FLT CENTER	301-982-5042
9. CO-INVESTIGATOR	**10. ORGANIZATION**	**11. TELEPHONE**
BRYAND, J.	GODDARD SPACE FLT CENTER	301-982-5042

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

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
DILLER, D.S.	NASA HDQTRS	OA/ES	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
APL FOR ANTENNAS			

26. INSTRUMENT TYPE	27. SECURITY
GFE TRANSPONDER, PWR AMPL, DIPLEXER	UNC

28. APPLICATION	29. SPACECRAFT
GEOD	GEOS C

30. PURPOSE

PRIMARY - PERFORM SAT-TO-SAT TRACKING EXPERIMENT WITH ATS-F TO DIRECTLY MEASURE SHORT PERIOD ACCELERATIONS IMPARTED BY GRAVITY FIELD AND TO DETERMINE POSITION. *** SECONDARY - SUPPORT EVALUATION OF S-BAND GROUND STATIONS IN UNIFIED EARTH-CENTERED REFERENCE SYSTEM.

31. PRINCIPLES OF OPERATION

THE S-BAND SUBSYSTEM WILL BE USED IN A SATELLITE-TO-SATELLITE (SST) TRACKING MODE (GRARR FORMAT) AND A USB (DOPPLER ONLY)/ GRARR GROUND-TO-SATELLITE TRACKING MODE. SIMULTANEOUS OPERATION IN THE TWO TRACKING MODES IS NOT POSSIBLE. THE EARTH VIEWING ANTENNA SYSTEM SHALL PROVIDE HEMISPHERICAL COVERAGE WITH GAIN GREATER THAN -2 DB WITHIN 60 DEGREES OF LOCAL VERTICAL. THE SST ANTENNA SYSTEM SHALL PROVIDE +3 DB GAIN IN THE DIRECTION OF THE ATS ANYWHERE IN A BAND OF + OR - 26 DEGREES FROM THE LONGITUDE OF ATS. THE MAXIMUM DAILY SCHEDULE OF OPERATION IS 60-MINUTE PERIODS PER ORBIT FOR TWO SETS OF THREE CONSECUTIVE ORBITS, EACH SET SEPERATED BY FOUR ORBITS.

32. PHENOMENA OBSERVED

33. MEASUREMENT RANGE

34. PRECISION AND ACCURACY

0.05 CM/SEC OVER A 10 SEC INTERGRATION INTERVAL.

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
2074.6375(R) 2253 (T) MHZ	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
		927 KM(MEAN)	115 DEGREES

46. SPECIAL REQUIREMENTS

47. COMPONENTS

TRANSPONDER AND PWR AMPLIFIER

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
12	17.91		3	36	

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	

62. TELEMETRY REQUIREMENTS

7 PARAMETERS ONCE PER MINUTE: RECEIVER LOCK, TRANSPONDER MODE STATUS, ANTENNA MODE.

63. ADVANTAGES AND LIMITATIONS

FURTHER SUPPORT NEW AND ESTABLISHED GEODETIC MEASURING SYSTEMS.

64. REFERENCES

GEOS-C SPACECRAFT EXPERIMENT REQUIREMENTS DOCUMENT, REV 1, 12 MAY 1972.

65. HISTORICAL REMARKS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
SOLAR COSMIC RAY AND TRAPPED PARTICLE	SCRTP	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0002

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
MASLEY, A. J.	MCDONNELL DOUGLAS	

9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
SATTERBLOM, P. R.	MCDONNELL DOUGLAS	

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

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B.B.	NASA HDQTRS	OA/ERN	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
		1974	

26. INSTRUMENT TYPE	27. SECURITY
PROTON-ALPHA-PARTICLE TELESCOPE AND SPECTROMETER	UNC

28. APPLICATION	29. SPACECRAFT
PARTICLES AND FIELDS	NIMBUS-F

30. PURPOSE

PRIMARY-TO IDENTIFY AND DIFFERENTIALLY MEASURE PARTICLE ENERGIES AND INTENSITIES OF (A) PROTONS BETWEEN 0.2-230 MEV IN 12 ENERGY. INTERVALS, (B) ALPHA PARTICLES 2-250 MEV IN 10 ENERGY INTERVALS, (C) ELECTRONS 15 KEV-1 MEV IN 5 ENERGY INTERVALS, (D) PROTONS >250 MEV AND ELECTRONS>1MEV***SECONDARY-STUDY GEOMAGNETICALLY TRAPPED AND PRECIPITATING RADIATION AND SOLAR COSMIC RADIATION.

31. PRINCIPLES OF OPERATION

THIS EXPERIMENT IS TO BE CONDUCTED IN CONJUNCTION WITH SIMULTANEOUS OBSERVATIONS OF AN IDENTICAL INTERCALIBRATED DETECTOR SYSTEM ON ATS-F AND-G IN SYNCHRONOUS ORBIT AT L=6.6. THE TELESCOPE CONSISTS OF THREE SOLID STATE DETECTORS. THE OUTER DECTECTOR IS A 30 MICRON DOUBLED DIFFUSED DETECTOR, THE SECOND IS 200 MICRON DOUBLE DIFFUSED, AND THE BACK DETECTOR IS A 2000 MICRON LITHIUM DRIFTED. ENERGY AND PARTICLE-TYPE DISCRIMINATION IS ACCOMPLISHED BY CONSIDERING BOTH THE RANGE AND ENERGY LOSS OF THE PARTICLE IN EACH DETECTOR WHERE IT CAUSES IONIZATION. THE LOWEST ENERGY PROTON AND ALPHA-PARTICLE CHANNEL IS DUE TO PARTICLES STOPPING IN THE FIRST DETECTOR. THE NEXT HIGHER TWO CHANNELS REQUIRE COINCIDENCE BETWEEN THE OUTER AND CENTER DETECTORS AND THE REMAINING CHANNELS REQUIRE COINCIDENCE BETWEEN THE CENTER AND BACK DETECTOR. THE TWO DIRECTIONAL PROTON-ALPHA-PARTICLE TELESCOPES ALLOW THE INVESTIGATION OF THE MECHANISM BY WHICH LOW ENERGY SOLOR COSMIC RAYS GAIN ENTRY INTO AND PROPAGATE WITHIN THE MAGNETOSPHERE. THE COMBINATION OF MAKING DETAILED PROTON AND ALPHA-PARTICLE SPECTRAL AND DIRECTIONAL MEASUREMENTS IN TWO MAGNETOSPHERE REGIONS PRESENTS A UNIQUE OPPORTUNITY TO DIRECTLY INVESTIGATE THIS COMPLEX PHENOMENON.

32. PHENOMENA OBSERVED

SEE ITEM 30

33. MEASUREMENT RANGE

SEE ITEM 30

34. PRECISION AND ACCURACY

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

38. FIELD OF VIEW	39. GROUND SWATH

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
	NA

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

46. SPECIAL REQUIREMENTS

47. COMPONENTS
SOLID STATE RADIATION DETECTORS, VIEWING PORTS, ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
16 LB	0.25 CU FT	4 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
IN-FLIGHT CALIBRATION	TELEMETRY	CONTINUOUS

62. TELEMETRY REQUIREMENTS

63. ADVANTAGES AND LIMITATIONS

64. REFERENCES
PRELIMINARY DATA SHEET FOR NIMBUS-F, NOV., 1970.

65. HISTORICAL REMARKS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
SOLAR-PROTON EXPERIMENT	SP	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0008

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	301-982-5042

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
	ESSA ES-86-67		11/66		OPERATIONAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SIOMKAJLO, J.	NESC/NOAA		202-655-4000

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
APPLIED PHYSICS LAB	SILVER SPRING,MARYLAND	1/70	NA

26. INSTRUMENT TYPE	27. SECURITY
COUNTER, SOLID-STATE DETECTOR-ARRAY	UNC

28. APPLICATION	29. SPACECRAFT
PARTICLES & FIELDS	ITOS-1

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 SP 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			1 YEAR

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

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
SOLAR-PROTON EXPERIMENT	SP	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0008

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	301-982-5042

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
	ESSA ES-86-67		11/66		OPERATIONAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SIOMKAJLO, J.	NOAA/NESC		202-655-4000

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
APPLIED PHYSICS LAB	SILVER SPRINGS,MARYLAND	12/70	NA

26. INSTRUMENT TYPE	27. SECURITY
COUNTER, SOLID-STATE DETECTOR-ARRAY	UNC

28. APPLICATION	29. SPACECRAFT
PARTICLES & FIELDS	NOAA-1

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 SP 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

f

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			1 YEAR

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

FLOWN ON ITOS-1.

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
SOLAR-PROTON EXPERIMENT	SP	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0008

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	301-982-5042

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
	ESSA ES-86-67		11/66		OPERATIONAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SIOMKAJLO, J.	NOAA/NESC		202-655-4000

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
APPLIED PHYSICS LAB	SILVER SPRINGS,MARYLAND	10/72	NA

26. INSTRUMENT TYPE	27. SECURITY
COUNTER, SOLID-STATE DETECTOR-ARRAY	UNC

28. APPLICATION	29. SPACECRAFT
PARTICLES & FIELDS	NOAA 2

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 SP 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			1 YEAR

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

FLOWN ON NOAA-1 AND ITOS-1

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
SOLAR-SCIENCE ELECTRON FLUX EXPERIMENT	SSED	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
ELECTRON COUNTER	09/01/72	0004

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	OA/ECD	202-755-2322

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.

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
TROPICAL WIND, ENERGY CONVERSION AND REFERENCE	TWECRL	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
LEVEL	09/01/72	0002

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
KELLOG, W. W.	NAT. CEN. FOR ATMOS. RES	

9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
SOUMI, V. E.	UNIVERSITY OF WISCONSON	

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

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B.B.	NASA HDQTRS	OA/ERN	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
		1974	

26. INSTRUMENT TYPE	27. SECURITY
RECEIVER, VHF	UNC

28. APPLICATION	29. SPACECRAFT
MET	NIMBUS-F

30. PURPOSE

PRIMARY-TO DETERMINE PATTERNS OF LARGE SCALE MOTIONS AT ABOUT THE 150 MB LEVEL IN THE TROPICS AND MID-LATITUDES IN THE SOUTHERN HEMISPHERE***SECONDARY-TO STUDY DYNAMICAL INTERALTIONS IN THE UPPER TROPOSPHERE BETWEEN MID-LATITUDE AND TROPICAL DISTURBANCES*** TERTIARY-TO MEASURE THE RATE OF CONVERSION OF POTENTIAL ENERGY TO KINETIC ENERGY AT THESE LEVELS.

31. PRINCIPLES OF OPERATION

THE OBJECT OF THE EXPERIMENT IS TO PROVIDE A METEOROLOGICAL BALLOON LOCATION AND DATA RETRIEVAL SYSTEM WITH THE NECESSARY COMMUNICATIONS AND DATA REDUCTION EQUIPMENT THAT WILL DETERMINE THE LOCATION OF 300 BALLOONS TO AN ACCURACY OF +-5 KM AT LEAST TWICE DAILY WITH AN INTERVAL BETWEEN OBSERVATIONS OF ABOUT TWO HOURS. THE PRINCIPLE INVOLVED IN THE LOCATION OF THE BALLOON PACKAGES IS A RANDOM ACCESS DOPPLER TECHNIQUE WHERE THE POSITION OF THE PLATFORM IS COMPUTED FROM THE DOPPLER FREQUENCY SHIFT. THE TRANSMITTED SIGNALS ARE MODULATED WITH THE DATA FROM THE ATMOSPHERIC SENSORS. EACH BALLOON WILL CARRY LOW DENSITY RADIO EQUIPMENT FOR TRANSMISSION TO THE NIMBUS OBSERVATORY AND SENSORS TO MEASURE AIR TEMPERATURE, PRESSURE, AND ALTITUDE. A RECEIVER ON THE SATELLITE WILL RECEIVE, STORE, AND RELAY THE SIGNALS FROM THE RANDOMLY TRANSMITTING BALLOONS TO FIX THEIR IDENTITIES, POSITIONS, AND TIMES OF LOCATION. THE SATELLITE ANTENNA WILL BE CIRCULARLY POLARIZED WITH A PEAK GAIN OF ABOUT 4 DB. THE RECEIVER WILL HAVE A NOISE FIGURE OF ABOUT 3 DB AND A PASSBAND OF ABOUT 30 KHZ. IT WILL TRANSLATE THE BALLOON TRANSMISSIONS TO BASEBAND AND DIRECTLY RECORD THEM ALONG WITH THE SPACECRAFT-DERIVED REFERENCE TONE AND THE NIMBUS CLOCK SIGNAL.

32. PHENOMENA OBSERVED

RADIO SIGNALS FROM BALLOONS

33. MEASUREMENT RANGE

VHF

34. PRECISION AND ACCURACY

SEE ITEM 31

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
400 MHZ		

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 CIRCULAR	SUN-SYNCH RETROGRADE

46. SPECIAL REQUIREMENTS

47. COMPONENTS
RECEIVER, MULTIPLEXER, TAPE TRANSPORT & ELECTRONICS, TRANSMITTER

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
32 LB	0.85 CU FT	69 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
	TELEMETRY	EVERY TWO HOURS

62. TELEMETRY REQUIREMENTS

63. ADVANTAGES AND LIMITATIONS

64. REFERENCES
PRELIMINARY DATA SHEET FOR NIMBUS-F, NOV., 1970.

65. HISTORICAL REMARKS

TRANSPONDER TECHNOLOGY EXPERIMENTS

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INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
C-BAND TRANSPONDER	CTRAN	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0004

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	OA/ECD	202-755-2322

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 0.7 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 GRARR 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

RANGE PRECISION 0.7M, ACCURACY 2M.

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

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
COHERENT C-BAND TRANSPONDER	CTRAN	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0001

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
JACKSON, B.M.	NASA WALLOPS STATION	703-824-3411

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

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
DILLER, D.S.	NASA HDQTRS	DA/ES	202-755-2322

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

26. INSTRUMENT TYPE	27. SECURITY
TRANSPONDER, COHEREN C-BAND	UNC

28. APPLICATION	29. SPACECRAFT
GEOD	GEOS C

30. PURPOSE

PRIMARY - SUPPORT CALIBRATION AND EVALUATION OF GROUND C-BAND RADAR SYSTEMS AND LOCATE THESE STATIONS IN UNFIED EARTH-CENTERED REFERENCE SYSTEM. *** SECONDARY - PROVIDE TRACKING COVERAGE IN SUPPORT OF RADAR ALTIMETER EXPERIMENT.

31. PRINCIPLES OF OPERATION

COHERENT TRANSPONDER ANTENNA WILL PROVIDE HEMISPERICAL COVERAGE WITH BEAM AXIS TOWARD CENTER OF EARTH. GAIN ON AXIS 5 DB NOMINAL, RIGHT-HAND CIRCULAR POLARIZATION. THE ALTITUDE CONTROL MAINTAINS BEAM AXIS WITHIN + OR- 10 DEGREES OF LOCAL VERTICAL AND S/C OSCILLATORY MOTION SHALL NOT DEGRADE PULSE DOPPLER SIGNAL BY MORE THAN 0.05 FT/SEC. MAXIMUM DAILY SCHEDULE OF 65 MINUTE RADIATING TIME PER ORBIT FOR 3 DAYS CONTINUOUSLY.

32. PHENOMENA OBSERVED

RF TRANSMISSION FROM GROUND STATIONS AT 5690 MHZ

33. MEASUREMENT RANGE

34. PRECISION AND ACCURACY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
5690 MHZ (RANDT)		

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	927 KM(MEAN)	115 DEGREES

46. SPECIAL REQUIREMENTS

OPERABLE SIMULTANEOUSLY WITH NON-COHERENT TRANSPONDER

47. COMPONENTS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
5 5	13.9	4	36		

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

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
NONE	NA	

62. TELEMETRY REQUIREMENTS

COMMAND- OFF, ON-NORMAL, ON-OVERRIDE
TELEMETRY - 6 PARAMETERS AND 2 MODE INDICATIONS INDICATIONS ONCE/MINUTE.

63. ADVANTAGES AND LIMITATIONS

64. REFERENCES

GEOS-C SPACECRAFT EXPERIMENT REQUIREMENTS DOCUMENT, REV 1, 12 MAY 1972.

65. HISTORICAL REMARKS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
DOPPLER BEACON	DBEAC	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	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	OA/ECD	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
JHU/JPL	SILVER SPRING,MD.	01/68	NA

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

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 NORMALLY 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

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
DOPPLER TRANSMITTER	DBEAC	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0001

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
ANDERLE, R.J.	NAVAL WEAPONS LAB	

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

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
DILLER, D.S.	NASA HDQTRS	OA/ES	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
JHU/APL	SILVER SPRINGS, MD.		

26. INSTRUMENT TYPE	27. SECURITY
BEACON, 2 RADIO-FREQUENCY TRANSMITTER	

28. APPLICATION	29. SPACECRAFT
GEOD	GEOS-C

30. PURPOSE

PRIMARY - TO REFINE KNOWLEDGE OF THE STRUCTURE OF THE EARTH'S GRAVITATIONAL FIELD.

31. PRINCIPLES OF OPERATION

A THREE FREQUENCY VERSION OF THIS DOPPLER TRANSMITTER HAS FLOWN ON GEOS-1 AND 2 AND HAS BEEN USED FOR GEODETIC RESEARCH IN EARLY NAVY SATELLITES. THE TRANSMITTERS OPERATE AT 162 AND 324 MHZ AND PERMIT THE COMPUTATION AND CORRECTION OF THE IONOSPHERIC REFRACTION EFFECT ON THE DOPPLER FREQUENCY. THE DOPPLER BEACONS USE THE MAIN POWER SUPPLY OF THE SPACECRAFT AND NORMALLY TRANSMIT CONTINUOUSLY.

32. PHENOMENA OBSERVED

33. MEASUREMENT RANGE

34. PRECISION AND ACCURACY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
162 AND 324 MHZ (TRANSMIT)	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	927 KM(MEAN)	115 DEGREE S

46. SPECIAL REQUIREMENTS

47. COMPONENTS
OSCILLATOR, FREQ MULTIPLIER, TOW TRANSMITTERS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
5.9 LB	10. CU FT	5 5WATTS		5 5WATTS	

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

TOW PARAMETERS PER XMTR ONCE PER MIN - FOUR MODE INDICATION>
AT LEAST ONCE PER MIN.

63. ADVANTAGES AND LIMITATIONS

64. REFERENCES

GEOS-C SPACECRAFT EXPERIMENT REQUIREMENTS DOCUMENT, REV 1,
12 MAY 1972.

65. HISTORICAL REMARKS

SIMILIAR TO GEOS-2 EXCEPT 2 FREQUENCIES VS 3.

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
TEN-POINT-SIX MICRON LASER EXPERIMENT	IRLAS	NA

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0002

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
MCAVOY, N.	GODDARD SPACE FLT CENTER	301-982-5042
9. CO-INVESTIGATOR	**10. ORGANIZATION**	**11. TELEPHONE**
COOPER, H. G.	BELL TELEPHONE LABS	201-582-3000

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

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
BURKE, J.R.	NASA HDQTRS	OA/ECS	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
BELL TELEPHONE LABS			

26. INSTRUMENT TYPE	27. SECURITY
TRANSPONDER,10.6 MICRON LASER	

28. APPLICATION	29. SPACECRAFT
COMM.	ATS-F

30. PURPOSE

PRIMARY-TO ESTABLISH THE FEASIBILITY AND VALUE OF A WIDE-BAND LASER COMMUNICATION LINK BETWEEN SATELLITES BY MEASURING SUCH PARAMETERS AS S/N, BIT ERROR RATE, AND SYSTEM EFFICIENCY***SEC-ONDARY-TO DETERMINE ATMOSPHERIC EFFECTS ON PROPAGATION AT 10.6 MICRONS.

31. PRINCIPLES OF OPERATION

THE EXPERIMENT HAS TWO PHASES: LASER TRANSMISSION ALONG A HIGH DATA RATE LINK BETWEEN SATELLITE AND GROUND TERMINALS, E.G. AT GSFC, ROSMAN, AND MOJAVE DESERT, BEFORE THE LAUNCH OF ATS-G; AND RECEPTION FROM ATS-G OF SIGNALS ORIGINATING FROM A LOW-ORBITING SATELLITE AND RETRANSMITTED VIA LASER. THE LATTER SIGNALS WILL BE RETRANSMITTED AT RF BY ATS-F TO GROUND. THE LASER/OPTICS ARE USED FOR BOTH RECEIVE AND TRANSMIT. THE MAJOR OPTICAL COMPONENT IS A 5-IN CASSEGRAIN REFLECTOR; THE COLLIMATING ELEMENT IS A NEGATIVE LENS; AND THE DETECTOR IS A SENSITIVE WIDEBAND HG-CD TELLURIDE CRYSTAL OPERABLE AT TEMPERATURES UP TO 100 DEG K, THUS ALLOWING RADIATIVE COOLING. IMC IS USED TO CORRECT FOR INSTA-BILITIES IN SATELLITE POINTING. THE COMPENSATOR OPERATES BY APPLYING VARYING VOLTAGES TO PIEZOELECTRIC BIMORPHS WHICH MOVE ATTACHED MIRRORS. DETECTION IS ACCOMPLISHED AFTER IMC BY HETER-ODYING THE INCOMING SIGINAL WITH A LOCAL OSCILLATOR SIGINAL. THE RETRANSMITTED LASER SIGNAL IS MODULATED BY VARYING THE LAS-ER'S RESONANT OSCILLATOR FREQUENCY. 0.7 WATTS OF DRIVE POWER PRODUCE 30 MHZ OF RF BANDWIDTH. OPTIONS ARE OPEN TO TRADE AMONG SIGNAL-TO-NOISE, MODULATOR POWER, BANDWIDTH, AND MODULATION IN-DEX.

32. PHENOMENA OBSERVED

10.6 MICRON RADIATION FROM ATS-G

33. MEASUREMENT RANGE

34. PRECISION AND ACCURACY

35. SPECTRAL RANGE		36. SPECTRAL RESOLUTION	37. TIME CONSTANT
10.6	MICRONS	30 MHZ	

38. FIELD OF VIEW	39. GROUND SWATH
0.2 BY 0.2 DEG	SEE ITEM 31

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.2 DEG	SEE ITEM 31

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

46. SPECIAL REQUIREMENTS
S/C RADIATIVE COOLER (70 TO 100 DEG K)

47. COMPONENTS
CO2 LASER, TELESCOPE, REFLECTOR, DETECTORS, ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
23 LB	1.8 CU FT	20 WATTS			3 YEARS

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
SOURC/SEN	NONE	NONE	SENSITIVE	THERMAL INSULATION

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
ACTIVE FREQUENCY CONTROL	REALTIME TELEMETRY	CONTINOUS

62. TELEMETRY REQUIREMENTS
NONE REQUIRED; EXPERIMENT CONSISTS OF COMMUNICATIONS WITH 1000 CHANNELS CAPACITY

63. ADVANTAGES AND LIMITATIONS

64. REFERENCES
1) MCAVOY, NELSON, ET AL. 10.6-MICRON LASER COMMUNICATIONS SYSTEM EXPERIMENT FOR ATS-F AND ATS-G, NO. X-524-68-206, GSFC, MAY, 1968.

65. HISTORICAL REMARKS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
INTERROGATION, RECORDING, AND LOCATION SYSTEM	IRLS	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
HOGAN, G.D.	GODDARD SPACE FLT CENTER	301-982-5042
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	OA/ERN	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
RADIATION, INC	MELBOURNE, FLORIDA	04/69 N	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

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
INTERROGATION, RECORDING, AND LOCATION SYSTEMS	IRLS	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0008

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
HOGAN, G. D.	GODDARD SPACE FLT CENTER	301-982-5042
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
					OPERATIONAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
SCHARDT, B.B.	NASA HDQTRS	OA/ERN	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
RADIATION, INC.	MELBOURNE, FLORIDA	04/70	NA

26. INSTRUMENT TYPE	27. SECURITY
TRANSPONDER, UHF	UNC

28. APPLICATION	29. SPACECRAFT
MET, COMM.	NIMBUS-4

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	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	0.3 CU FT	25 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. PM-6713, JUNE 8, 1967.

65. HISTORICAL REMARKS

SIMILAR TO THE NIMBUS 3 IRLS

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
MICROWAVE TRANSPONDER	MTRAN	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
DARCEY, R.J.	GODDARD SPACE FLT CENTER	301-982-5041

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
				12/66	OPERATIONAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
BURKE, J.R.	NASA HDQTRS	OA/ECS	202-755-2322

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

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

28. APPLICATION	29. SPACECRAFT
COMM	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 SPACE-CRAFT TRANSMITTED SIGNAL INDEPENDENT OF THE NUMBER OF CHANNELS IN USE.

31. PRINCIPLES OF OPERATION

THIS INSTRUMENT IS IDENTICAL TO THAT 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 COMM-UNICATION TRANSPONDER TO PROVIDE A SYSTEM ELEMENT CAPABLE OF AC-CEPTING AND HANDLING ANY TYPE OF COMMUNICATIONS TRAFFIC OR WIDE-BAND 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 SIG-NALS 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

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 9100 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 TLELMETRY	CONTINUOUS

62. TELEMETRY REQUIREMENTS

NA

63. ADVANTAGES AND LIMITATIONS

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 INDENTICAL TO THAT USED ON ATS 2 AND ATS 3.

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
MICROWAVE TRANSPONDER	MTRAN	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
DARCEY, R.J.	GODDARD SPACE FLT CENTER	301-982-5042

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	OA/ECS	202-755-2322

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

SYSTEM IS IDENTICAL TO THAT 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 MECHANICAL DESPUN PHASED ARRAY, GIVING 15-18 DB OF GAIN. THE AFFECTIVE 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

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
NON-COHERENT C-BAND TRANSPONDER	NCTRAN	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0001

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
JACKSON, E.B.	NASA WALLOPS STATION	703-824-3411

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

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
DILLER, D.S.	NASA HDQTS	OA/ES	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
VEGA PRECISION LABS	VIENNA, VIRGINIA		

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

28. APPLICATION	29. SPACECRAFT
GEOD	GEOS-C

30. PURPOSE

PRIMARY - SUPPORT CALIBRATION AND EVALUATION OF GROUND C-BAND RADAR SYSTEMS AND LOCATE THESE STATIONS IN UNIFIED EARTH-CENTERED REFERENC SYSTEM. *** SECONDARY - PROVIDE TRACKING COVERAGE IN SUPPORT OF RADAR ALTIMETER EXPERIMENT.

31. PRINCIPLES OF OPERATION

THE TRANSPONDER RECEIVES A PAIR OF PULSES 8 MICORSEC APART FROM A GROUND STATION. AFTER THE FIRST PULSE IS RECEIVED AN INTERNAL GATING PULSE IS GENERATED 8 MICROSEC LATER. WHEN THE GATING PULSE IS PRESENT THE SECOND RECEIVED PULSE WILL GENERATE A RETURN PULSE AFTER A FIXED DELAY. RANGING IS OBTAINED AT THE GROUND VIA THE TIME REQUIRED TO MAKE THE ROUND-TRIP LESS THE FIXED DELAY IN THE S/C. MAXIMUM DAILY SCHEDULE OF 65 MINUTE RADIATING TIME PER ORBIT FOR 3 DAYS CONTINUOUSLY.

32. PHENOMENA OBSERVED

RF TRANSMISSION FROM GROUND STATIONS AT 5690 MHZ

33. MEASUREMENT RANGE

34. PRECISION AND ACCURACY

RANGE PRECISION 0.7 M, ACCURACY 2 M

35. SPECTRAL RANGE
5690 (R)TO 5765 (T) MHZ

36. SPECTRAL RESOLUTION

37. TIME CONSTANT

38. FIELD OF VIEW

39. GROUND SWATH

40. ANGULAR RESOLUTION
NA

41. SPATIAL RESOLUTION
NA

42. POINTING ACCURACY
NA

43. POINTING RATE
NA

44. ALTITUDE
927 KM(MEAN)

45. INCLINATION
115 DEG

46. SPECIAL REQUIREMENTS
OPERABLE SIMULTANEOUSLY WITH COHERENT TRNASPONDER

47. COMPONENTS
VEGA MODEL 313C TRANSPONDER

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
4 LB	8.334CU FT		4 WATTS	28 WATTS	

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

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
NONE	NA	

62. TELEMETRY REQUIREMENTS
COMMAND-OFF, ON-NORMAL, ON-OVERRIDE
TELEMETRY-6 PARAMETERS AND 2 MODE INDICATIONS ONCE/MIN

63. ADVANTAGES AND LIMITATIONS

64. REFERENCES
GEOS-C SPACECRAFT EXPERIMENT REQUIREMENTS DOCUMENT, REV 1, 12 MAY 1972.

65. HISTORICAL REMARKS
SAME AS COHERENT TRANSPONDER IN GEOS-2.

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
OPTICAL BEACON	OBEAC	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
BERBERT, J.H.	GODDARD SPACE FLT CENTER	301-982-5042

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	OA/ECD	202-755-2322

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

26. INSTRUMENT TYPE	27. SECURITY
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.

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
OMEGA POSITION-AND-LOCATION EQUIPMENT EXPERIMENT	OPLE	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
LAUGHLIN, C.	GODDARD SPACE FLT CENTER	301-982-5042
9. CO-INVESTIGATOR	**10. ORGANIZATION**	**11. TELEPHONE**
HILTON, G.E.	GODDARD SPACE FLT CENTER	301-982-5042

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	OA/ECS	202-755-2322

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, 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	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
SEE ITEM 31		

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. COMPONENTS

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. 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	NA	AS PROGRAMMED

62. TELEMETRY REQUIREMENTS

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

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
POSITION LOCATION AND AIRCRAFT COMMUNICATIONS	PLACE	NA

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
LAUGHLIN, C. R.	GODDARD SPACE FLT CENTER	301-982-5042
9. CO-INVESTIGATOR	**10. ORGANIZATION**	**11. TELEPHONE**
ALLEN, W.	GODDARD SPACE FLT CENTER	301-982-5042

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

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
BURKE, J.R.	NASA HDQTRS	OA/ECS	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME

26. INSTRUMENT TYPE	27. SECURITY
TRANSPONDER, 1.6 AND 8.1GHZ RECEIVE, 1.5 AND 7.3GHZ TRANSMIT	UNC

28. APPLICATION	29. SPACECRAFT
NAV, COMM	ATS-F

30. PURPOSE

PRIMARY-TO DETERMINE THE CAPABILITIES OF SYNCHRONOUS SATELLITES TO RELAY COMMUNICATION AND NAVIGATION INFORMATION BETWEEN GROUND AND INFLIGHT AIRCRAFT***SECONDARY-TO DETERMINE THE ACCURACY OF SEVERAL POSITION LOCATION TECHNIQUES USING SYNCHRONOUS SATELLITES.

31. PRINCIPLES OF OPERATION

IN THIS EXPERIMENT THE SATELLITE RELAYS VOICE AND DIGITAL INFORMATION BETWEEN THE GROUND AND FLYING AIRCRAFT. IN ADDITION TO NORMAL COMMUNICATIONS,NAVIGATION SIGNALS ARE RELAYED BY ATS-F FROM AIRCRAFT TO A GROUND CONTROL CENTER FOR POSITION DETERMINATION. A DUAL SATELLITE RANGE-RANGE POSITION LOCATION METHOD MAKING NEAR SIMULTANEOUS RANGE MEASUREMENTS THROUGHT THE USE OF ATS-E AND -F IS INCLUDED. COMMUNICATION TESTS USE THE MULTIPLE ACCESS MODE IN WHICH THE PRIMARY GROUND STATION TRANSMITS A MULTI-CHANNEL SIGNAL AT 8.1 GHZ, CONTAINING BOTH VOICE AND DIGITAL DATA. 2 ADDITIONAL GROUP STATIONS ALSO TRANSMIT VOICE IN THIS BAND TO THE SATELLITE. AT THE SATELLITE THE INCOMING SIGNALS ARE DEMODULATED AND THE RESULTING SIGNAL IS PHASE MODULATED ONTO A 1.55 GHZ CARRIER GENERATED ON-BOARD AND PHASE-LOCKED TO THE PRIMARY GROUND STATION CARRIER, MAINTAINING SIGNAL COHERENCE UP TO 200 AIRCRAFT TRANSMIT TONES, DIGITAL DATA, AND ANALOG VOICE TO THE SATELLITE AT ABOUT 1.65 GHZ. THE SATELLITE PROCESSES THESE SIGNALS IN MUCH THE SAME WAY AS THE RECEIVED SIGNALS FROM THE GROUND AND RETRANSMITS THEM TO THE GROUND AT ABOUT 7.5 GHZ.

32. PHENOMENA OBSERVED

ADDRESS-CODED RF TRANSMISSION FROM NASA GROUND STATIONS AND A/C

33. MEASUREMENT RANGE

RECEIVER NOISE FIGURE DOES NOT EXCEED 5 DB .

34. PRECISION AND ACCURACY

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
1550.0 TO 8250. MHZ	250. HZ	150.0 MSEC

38. FIELD OF VIEW	39. GROUND SWATH
28. BY 28. DEG	9200 NM

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
NA	NA

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
NA	NA	GEO/SYNCH	0 DEG

46. SPECIAL REQUIREMENTS

47. COMPONENTS

2 HORN ANTENNAS, 30 FT PAROBOLIC DISH, LINEAR TRANSCEIVER

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

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

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

62. TELEMETRY REQUIREMENTS

63. ADVANTAGES AND LIMITATIONS

INCORPORATES A PHASE-LOCK-LOOP TO PROVIDE COHERENT REFERENCE SOURCE FOR FREQUENCY TRANSLATION CIRCUITS.

64. REFERENCES

1)POSITION LOCATION AND AIRCRAFT COMMUNICATION EQUIPMENT (PLACE) DOC. # X-731-67-159, GSFC, APRIL 1967. ***2) ADDENDUM TO POSITION LOCATION AND AIRCRAFT COMMUNICATIONS EXPERIMENT DISCRIPTION (6SFC X-733-67-577) APRIL 1969.

65. HISTORICAL REMARKS

CAN USE ATS-5 WITH SOME MODIFICATION AND INCOHERENT SOURCE.

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
RADIO FREQUENCY INTERFERENCE MEASUREMENT	RFIM	NA
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
HENRY, V. F.	GODDARD SPACE FLT CENTER	301-982-5042
9. CO-INVESTIGATOR	10. ORGANIZATION	11. TELEPHONE
BOUCHER, R. A.	HUGHES AIRCRAFT COMPANY	

12. CONTRACT TYPE	13. CONTRACT NUMBER	14. FLASH INDEX NUMBER	15. START DATE	16. COMPLETION DATE	17. STATUS
	NAS5-11657				

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
BURKE, J.R.	NASA HDQTRS	OA/ECS	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
HUGHES AIRCRAFT COMPANY			

26. INSTRUMENT TYPE	27. SECURITY
TRANSPONDER, MICROWAVE, 6 GHZ RECEIVE, 4 GHZ TRANSMIT	UNC

28. APPLICATION	29. SPACECRAFT
COMM	ATS-F

30. PURPOSE

PRIMARY-TO INVESTIGATE SPECTRUM SHARING BETWEEN SATELLITE TELECOMMUNICATION SYSTEMS AND TERRESTRIAL POINT-TO-POINT RADIO RELAY SYSTEMS IN THE 4 GHZ AND 6 GHZ COMMON CARRIER BANDS.

31. PRINCIPLES OF OPERATION

THIS EXPERIMENT CONCISTS OF RECEPTION AND RETRANSMISSION OF TERRESTRIAL MICROWAVE SIGNALS BY A SYNCHRONOUS SATELLITE. THE TERRESTRIAL SIGNALS IN THE SHARED FREQUENCY BAND ARE RE-CEIVED AT THE SATELLITE AND THEN TRANSMITTED TO A SATELLITE GROUND STATION FOR MEASUREMENT OF FREQUENCY, AMPLITUDE, PULSE WIDTH, AND PULSE REPETITION FREQUENCY, AS WELL AS ANALYSIS OF SOURCE LOCATION. THE INSTRUMENT IS A BROADBAND, SINGLE-CONVER-SION LINEAR REPEATER UTILIZING THE SATELLITE'S 30-FT PARABOLIC DISH ANTENNA AND RECEIVING AT 5925 TO 6425 MHZ AND TRANSMITTING AT 3700 TO 4200 MHZ. THE RECEIVED SIGNALS ARE AMPLIFIED BY TUNNEL DIODE AMPLIFIERS, DOWN-CONVERTED TO THE TRANSMIT FREQUEN-CY AND FURTHER AMPLIFIED BY TRAVELLING WAVE TUBES. A NOTCH FILTER REJECTS RADAR TRANSMISSION ADJACENT TO THE RECEIVER FREQUENCY. THE GROUND RECEIVER CAN BE EITHER THE ROSEMAN, N.C. FACILITY OR A TRANSPORTABLE EARTH TERMINAL.

32. PHENOMENA OBSERVED

RADIATION EMITTED FROM ALL TERRESTRIAL SOURCES IN THE 6 GHZ BAND

33. MEASUREMENT RANGE

INTERFERENCE SOURCE OF 5-10 DBW EIRP DETECTABLE; 40 DB DYN RANGE

34. PRECISION AND ACCURACY

RECEIVER NOISE FIGURE-7 DB MAX

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
5925.0 TO 6425.0 MHZ	10.0 KHZ	

38. FIELD OF VIEW	39. GROUND SWATH
35.0 BY 35.0 DEG	LIMB-TO-LIMB (8500 NM)

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
0.1 DEG	50 MILES IN E-W DIRECTION, 70 MILES IN N-S DIRECTION

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
NA	NA	GEO/SYNCH	0. DEG

46. SPECIAL REQUIREMENTS

NONE

47. COMPONENTS

TRANSMITTERS, RECEIVERS AND ASSOCIATED ELECTRONICS

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
10 LB	1. CU FT	40 WATTS			1 YEAR

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

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
ON GROUND	REALTIME	16.5 MIN PER DAY

62. TELEMETRY REQUIREMENTS

10 DIGITAL, 12 ANALOG CHANNELS

63. ADVANTAGES AND LIMITATIONS

64. REFERENCES

1) RADIO FREQUENCY INTERFERENCE MEASUREMENT EXPERIMENT DESIGN FOR THE APPLICATION TECHNOLOGY SATELLITE BY VARICE E. HENRY AND JOHN J. KELLEHER, NASA TN D5041-MAY, 1969, 2) FINAL DESIGN RE-PORT FOR RADIO-FREQUENCY INTERFERENCE EXPERIMENT, CONTRACT NAS5-2150A, HUGHES AIRCRAFT CO., AUGUST, 1970.

65. HISTORICAL REMARKS

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
SATELLITE RANGE AND RANGE-RATE EXPERIMENT	GRARR	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
BERBERT, J.H.	GODDARD SPACE FLT CENTER	301-982-5042

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	OA/ECD	202-755-2322

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.

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.

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
SEQUENTIAL COLLATION OF RANGE SYSTEM	SECOR	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
MCCALL, J.		
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	OA/ECD	202-755-2322

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.

B

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
ATS/F/NIMBUS-E TRACKING AND DATA RELAY EXPERIMENT	TDRE	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0002

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
PICKARD, R.H.	GODDARD SPACE FLT CENTER	301-982-5042
9. CO-INVESTIGATOR	**10. ORGANIZATION**	**11. TELEPHONE**
HEFFERNAN, P.J.	GODDARD SPACE FLT CENTER	301-982-5042

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

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
BURKE, J.R.	NASA HDQTRS	OA/ECS	202-755-2322

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

26. INSTRUMENT TYPE	27. SECURITY
TRANSPONDER, RECEIVER AND DECODER, TELEMETRY TRANSMITTER	UNC

28. APPLICATION	29. SPACECRAFT
COMM, SATELLITE TRACKING	ATS-F AND NIMBUS-E

30. PURPOSE

PRIMARY-TO DEVELOP TECHNOLOGY LEADING TO AN OPERATIONAL SYSTEM OF TRACKING AND DATA RELAY SATELLITES (TDRS) BY PROVIDING DATA ON PERFORMANCE OF THE REAL-TIME COMMAND AND TELEMETRY RELAY AND LONG-ARC RANGE AND RANGE-RATE TRACKING OF A LOW ALTITUDE SATELLITE***SECONDARY-TO DETERMINE NIMBUS-E ORBIT TO WITHIN 50 METERS IN A TOTAL ELAPSED TIME OF SEVERAL HOURS.

31. PRINCIPLES OF OPERATION

A RANGE AND RANGE RATE SIGNAL USING 100KHZ AS THE HIGHEST TRACKING TONE IS GENERATED BY PHASE MODULATION OF A 70 MHZ CARRIER ALL SIDE TONES, THE 70MHZ CARRIER, AND ALL CONVERSION FREQUENCIES ARE SYNTHESIZED FROM A SINGLE STATION FREQUENCY STANDARD. THE TRACKING SIGNAL IS CONVERTED TO C-BAND AND TRANSMITTED UP. THE SIGNAL IS RECEIVED AT ATS-F AND COHERENTLY TRANSLATED TO 1.8 GHZ. THE SIGNAL IS THEN RELAYED TO NIMBUS-E AND RETRANSMITTED BACK TO ATS-F FOR COHERENT RETRANSMISSION TO THE GROUND. UPON RECEPTION AT THE ATS GROUND STATION, RANGE MEASUREMENTS AND RANGE-RATE MEASUREMENTS ARE MADE. FINALLY, THE OBSERVED DATA (WITH TIME TAGS) ARE PUNCHED ON PAPER TAPE FOR TRANSMISSION OR SHIPMENT TO THE GSFC COMPUTING CENTER. THE BASIC CONCEPT IS TO ESTABLISH ATS-F AS A HIGHEST PERFORMANCE S-BAND COMMAND, DATA ACQUISTION AND RANGE AND RANGE-RATE TRACKING STATION IN EQUATORIAL SYNCHRONOUS ORBIT. THE 30-FOOT DIAMETER ATS-F PARABOLIC REFLECTER WILL BE PROGRAMMED FOR OPEN-LOOP POINTING AT NIMBUS-E AS THE LATTER MOVES ACROSS THE EARTH IN ITS 600 NM POLAR ORBIT. NIMBUS-E WILL CARRY A RANGE AND RANGE-RATE TRANSPONDER AND A STEERABLE ANTENNA TO COMPENSATE FOR INCREASED FREE SPACE PROPOGATION LOSSES ENCOUNTERED IN A TRACKING AND DATA RELAY GEOMETRY.

32. PHENOMENA OBSERVED

C-BAND AND S-BAND RADIO SIGNALS

33. MEASUREMENT RANGE

NA

34. PRECISION AND ACCURACY

50 METERS IN SEVERAL HOURS ELAPSED TRACKING TIME

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

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

46. SPECIAL REQUIREMENTS

47. COMPONENTS

TRANSPONDER,

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/SEN	NONE	NONE		

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

62. TELEMETRY REQUIREMENTS

TEST DATA TRANSMITTED AT RATES OF 50, 100, 200, AND 400 KBPS. NIMBUS-E DATA TRANSMITTED VIA ATS-F AT 4 KBPS.

63. ADVANTAGES AND LIMITATIONS

WILL PROVIDE FAST HIGHLY ACCURATE TRACKING INFORMATION.

64. REFERENCES

1) PICKARD, R. H. AND HEFFERNAN, P. J. THE ATS-F/NIMBUS-E TRACKING AND DATA RELAY EXPERIMENT, GSFC PUBLICATION, OCTOBER, 1970.

65. HISTORICAL REMARKS

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
NIMBUS-E/ATS-F TRACKING AND DATA RELAY EXPERIMENT	TDRE	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	C9/01/72	0002

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
PICKARD, R.H.	GODDARD SPACE FLT CENTER	301-982-5042
9. CO-INVESTIGATOR	**10. ORGANIZATION**	**11. TELEPHONE**
HEFFERNAN, P.J.	GODDARD SPACE FLT CENTER	301-982-5042

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

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
BURKE, J.R	NASA HDQTRS	OA/ECS	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
NA	NA	12/72	

26. INSTRUMENT TYPE	27. SECURITY
TRANSPONDER, RECEIVER AND DECODER, TELEMETRY TRANSMITTER	UNC

28. APPLICATION	29. SPACECRAFT
COMM, SATELLITE TRACKING	NIMBUS-E AND ATS-F 0001

30. PURPOSE

PRIMARY-TO DEVELOP TECHNOLOGY LEADING TO AN OPERATIONAL SYSTEM OF TRACKING AND DATA RELAY SATELLITES (TDRS) BY PROVIDING DATA ON PERFORMANCE OF THE REAL-TIME COMMAND AND TELEMETRY RELAY AND LONG-ARC RANGE AND RANGE-RATE TRACKING OF A LOW ALTITUDE SATEL-LITE***SECONDARY-TO DETERMINE NIMBUS-E ORBIT TO WITHIN 50 METERS IN A TOTAL ELAPSED TIME OF SEVERAL HOURS.

31. PRINCIPLES OF OPERATION

A RANGE AND RANGE RATE SIGNAL USING 100KHZ AS THE HIGHEST TRACK-ING TONE IS GENERATED BY PHASE MODULATION OF A 70 MHZ CARRIER ALL SIDE TONES, THE 70MHZ CARRIER, AND ALL CONVERSION FREQUEN-CIES ARE SYNTHESIZED FROM A SINGLE STATION FREQUENCY STANDARD. THE TRACKING SIGNAL IS CONVERTED TO C-BAND AND TRANSMITTED UP. THE SIGNAL IS RECEIVED AT ATS-F AND COHERENTLY TRANSLATED TO 1.8 GHZ. THE SIGNAL IS THEN RELAYED TO NIMBUS-E AND RETRANSMITTED BACK TO ATS-F FOR COHERENT RETRANSMISSION TO THE GROUND. UPON RECEPTION AT THE ATS GROUND STATION, RANGE MEASUREMENTS AND RANGE-RATE MEASUREMENTS ARE MADE. FINALLY, THE OBSERVED DATA (WITH TIME TAGS) ARE PUNCHED ON PAPER TAPE FOR TRANSMISSION OR SHIPMENT TO THE GSFC COMPUTING CENTER. THE BASIC CONCEPT IS TO ESTABLISH ATS-F AS A HIGHEST PERFORMANCE S-BAND COMMAND, DATA ACQUISTION AND RANGE AND RANGE-RATE TRACKING STATION IN EQUA-TORIAL SYNCHRONOUS ORBIT. THE 30-FOOT DIAMETER ATS-F PARABOLIC REFLECTER WILL BE PROGRAMMED FOR OPEN-LOOP POINTING AT NIMBUS-E AS THE LATTER MOVES ACROSS THE EARTH IN ITS 600 NM POLAR ORBIT. NIMBUS-E WILL CARRY A RANGE AND RANGE-RATE TRANSPONDER AND A STEERABLE ANTENNA TO COMPENSATE FOR INCREASED FREE SPACE PROPO-GATION LOSSES ENCOUNTERED IN A TRACKING AND DATA RELAY GEOMETRY.

32. PHENOMENA OBSERVED

C-BAND AND S-BAND RADIO SIGNALS

33. MEASUREMENT RANGE

NA

34. PRECISION AND ACCURACY

50 METERS IN SEVERAL HOURS ELAPSED TRACKING TIME

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

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

46. SPECIAL REQUIREMENTS

47. COMPONENTS
TRANSPONDER,

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/SEN	NONE	NONE		

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

62. TELEMETRY REQUIREMENTS
TEST DATA TRANSMITTED AT RATES OF 50, 100, 200, AND 400 KBPS. NIMBUS-E DATA TRANSMITTED VIA ATS-F AT 4 KBPS.

63. ADVANTAGES AND LIMITATIONS
WILL PROVIDE FAST HIGHLY ACCURATE TRACKING INFORMATION.

64. REFERENCES
1) PICKARD, R. H. AND HEFFERNAN, P. J. THE ATS-F/NIMBUS-E TRACKING AND DATA RELAY EXPERIMENT, GSFC PUBLICATION, OCTOBER, 1970.

65. HISTORICAL REMARKS

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
TELEVISION RELAY USING SMALL TERMINALS	TRUST	NA
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0003

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
MILLER, J. E.	GODDARD SPACE FLT CENTER	301-982-5042
9. CO-INVESTIGATOR	**10. ORGANIZATION**	**11. TELEPHONE**
WHALEN, A.A.	GODDARD SPACE FLT CENTER	301-982-5042

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

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
BURKE, J.R.	NASA HDQTRS	OA/ECS	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME

26. INSTRUMENT TYPE	27. SECURITY
TRANSPONDER, 860 MHZ/TRANSMITTER, 6 GHZ/RECEIVER	UNC

28. APPLICATION	29. SPACECRAFT
COMM	ATS-F

30. PURPOSE

PRIMARY- TO DEVELOP TECHNOLOGY FOR TRANSMITTING TELEVISION TO SMALL GROUND TERMINALS FROM SYNCRONOUS ALTITUDE***SECONDARY-TO OBSERVE AND COMPARE WITH THEORETICAL PREDICTIONS THE EFFECTS OF IONOSPHERIC DISPERSION ON SYSTEM PERFORMANCE AS A FUNCTION OF ELECTRON DENSITY, GROUND STATION LOCATION, AND OTHER SYSTEM VARIABLES; ALSO TO PROVIDE ADVICE AND CONSULTATION TO INDIA.

31. PRINCIPLES OF OPERATION

THE EXPERIMENT CONSISTS OF RELAYING TV SIGNALS FROM GROUND STATIONS DIRECTLY TO SMALL INEXPENSIVE RECEIVERS VIA ATS-F OBVIATING THE LARGE ANTENNAS AND LOCAL TRANSMITTERS PRESENTLY USED. FM SIGNALS ARE SENT TO THE SATELLITE AT 6 GHZ & RELAYED AT 860 MHZ. IN ADDITION TO TESTS OF BLACK-AND-WHITE AND COLOR RECEPTION QUALITY IN THE U.S., THE INDIAN GOVERNMENT WILL RELAY EDUCATIONAL PROGRAMS TO VILLAGES THROUGHOUT INDIA. TO PROVIDE NECESSARY SATELLITE EIRP,SATELLITE USES A 30 FT PARABOLIC TRANSMITTING ANTENNA AND GENERATES 80 WATTS OF TRANSMITTING POWER. IT IS ESTIMATED THAT THE RECEIVED VIDEO PICTURE WILL BE THE EQUIVALENT OF A TA50 GRADE 2 WITH A MARGIN GREATER THAN 6 DB.THE FREQUENCY TRANSLATION TECHNIQUE IS THE SAME USED ON EARLIER SATELLITES FOR TV RELAY. SIGNALS SENT TO THE SATELLITE FOR TESTS WITHIN THE U.S. ARE EITHER 525-LINE (U.S. STANDARD) OR 625-LINE (EUROPEAN STANDARD) VIDEO SIGNALS AND ASSOCIATED SOUND. AT THE SATELLITE THE SIGNAL IS AMPLIFIED (HARD-LIMITED), CONVERTED TO 860 MHZ AND POWER AMPLIFIED FOR RELAYING. GROUND RECEIVERS HAVE A CIRCULARLY POLARIZED, 10-FT DIAMETER ANTENNA, AND LESS THAN 100 DEG K EQUIVALENT SYSTEM NOISE TEMPERATURE.

32. PHENOMENA OBSERVED

IONOSPHERIC PROPAGATION ANOMALIES AT 860 MHZ.

33. MEASUREMENT RANGE

6 DB NOISE FIGURE

34. PRECISION AND ACCURACY

NA

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
845.0 TO 875.0 MHZ	20. MHZ	

38. FIELD OF VIEW	39. GROUND SWATH
35 BY 35 DEG	LIMB-TO-LIMB (10400 NM FROM GEOSYNCH ALT)

40. ANGULAR RESOLUTION	41. SPATIAL RESOLUTION
NA	NA

42. POINTING ACCURACY	43. POINTING RATE	44. ALTITUDE	45. INCLINATION
		GEOSYNC	0 DEG

46. SPECIAL REQUIREMENTS

47. COMPONENTS

860 MHZ TRANSMITTER, S/C TRANSPONDER & 30 FT ANTENNA.

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
20 LB	1.5 CU FT	160 WATTS			

54. RF INTERFERENCE	55. MAGNETIC INTERFERENCE	56. NUCLEAR INTERFERENCE	57. THERMAL INTERFERENCE	58. SHIELDING
SOURSE/SEN	NONE	NONE	SENSITIVE	

59. CALIBRATION	60. DATA RECOVERY	61. FREQUENCY OF OBSERVATION
NONE	REALTIME	A FEW HOURS/DAY

62. TELEMETRY REQUIREMENTS

SEE ITEM 31

63. ADVANTAGES AND LIMITATIONS

64. REFERENCES

1) HEFFERNAN, PAUL J., (TRUST), GSFC, MAY 1968***2) ATS-F SPACE-CRAFT PERFORMANCE REQUIREMENTS FOR TRUST EXPERIMENT, GSFC DOC NO-ITI 0100. *** U.S.-INDIA ETV AGREEMENT,NASA PRESS RELEASE NO; 69-135, SEPT.18,1969.

65. HISTORICAL REMARKS

EXPERIMENT TO BE INCLUDED IN ATS-G MISSION.

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
VHF TRANSPONDER	VTRAN	
(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
CORRIGAN, J.P.	GODDARD SPACE FLT CENTER	301-982-5042
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
	NAS5-9593		05/65	12/66	OPERATIONAL

18. MONITOR	19. AGENCY	20. PGM OFFICE	21. TELEPHONE
BURKE, J.R.	NASA HDQTRS	OA/ECS	202-755-2322

22. VENDOR	23. LOCATION	24. FLIGHT DATE	25. LEAD TIME
HUGHES-RES + DEVELOP DIV	CULVER CITY, CALIFORNIA	12/66	NA

26. INSTRUMENT TYPE	27. SECURITY
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, UPCONVERTED 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 OBSERVATION PLATFORMS AND GROUND CONTROL STATIONS

35. SPECTRAL RANGE	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
135.6 TO 149.22 MHZ	NA	

38. FIELD OF VIEW	39. GROUND SWATH
17.3 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
30 LB				90 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

64. REFERENCES

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.

65. HISTORICAL REMARKS

SIMILAR TO INSTRUMENT FLOWN ON ATS 3.

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
VHF TRANSPONDER	VTRAN	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0004

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
CORRIGAN, J.P.	GODDARD SPACE FLT CENTER	301-982-5042
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	OA/ECS	202-755-2322

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

26. INSTRUMENT TYPE	27. SECURITY
REPEATER, ACTIVE FREQUENCY TRANSLATION	UNC

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 AIR-CRAFT WITHIN SATELLITE RANGE.***SECONDARY-DEMONSTRATE FEASI-BILITY 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 REPEAT-ER THAT RECEIVES AT A FREQUENCY OF 149.22 MHZ AND TRANSMITS AT A FREQUENCY OF 135.6 MHZ. THE REPEATER BOTH RECEIVES AND TRANS-MITS 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 RELA-TIVE POSITION OF EACH DIPOLE ANTENNA. THE OUTPUT OF EACH RE-CEIVER 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 AMPLI-FIELD TO AN OUTPUT LEVEL OF 5 WATTS. THE TRANSMITTER UNITS IN-TRODUCE 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	37. TIME CONSTANT
135.6 TO 149.22 MHZ	NA	

38. FIELD OF VIEW	39. 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

INSTRUMENT RESUME

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
WEATHER FACSIMILE EXPERIMENT	WEFAX	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
WISHNA, S.	GODDARD SPACE FLT CENTER	301-982-5042
9. CO-INVESTIGATOR	**10. ORGANIZATION**	**11. TELEPHONE**
HOLMES, D.W.	NOAA/NESC	301-655-4000

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	OA/ECS	202-755-2322

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

26. INSTRUMENT TYPE	27. SECURITY
TRANSPONDER	UNC

28. APPLICATION	29. SPACECRAFT
MET, COMM	ATS 1

30. PURPOSE

PRIMARY-TO DETERMINE OPERATIONAL FEASIBILITY OF DISSEMINATING METEOROLOCICAL 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 FEASIBILITY TESTS CONDUCTED BY 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	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
149.22 AND 135.60 MHZ		

38. FIELD OF VIEW	39. GROUND SWATH
17.3 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
VHF TRANSPONDER, ANTENNA SYSTEM, DIPLEXER

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

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
		AS PROGRAMMED

62. TELEMETRY REQUIREMENTS
3 KHZ INFORMATION BANDWIDTH

63. 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: IN-TERIM 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.

INSTRUMENT RESUME
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD. 20771

1. TITLE	2. ACRONYM	3. EXP NO
WEATHER FACSIMILE EXPERIMENT	WEFAX	

(TITLE CONT.)	4. RESUME DATE	5. VERSION
	09/01/72	0005

6. PRINCIPAL INVESTIGATOR	7. ORGANIZATION	8. TELEPHONE
HOLMES, D.W.	NOAA/NESC	301-655-4000
9. CO-INVESTIGATOR	**10. ORGANIZATION**	**11. TELEPHONE**
WISHNA, S.	GODDARD SPACE FLT CENTER	301-982-5042

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	OA/ECS	202-755-2322

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, VHF	UNC

28. APPLICATION	29. SPACECRAFT
MET, COMM	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	36. SPECTRAL RESOLUTION	37. TIME CONSTANT
149.22 AND 135.0 MHZ		

38. FIELD OF VIEW	39. GROUND SWATH
17.3 DEG	LIMB-TO-L'IMB(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

VHF TRANSPONDER, ANTENNA SYSTEM, DIPLEXER

48. WEIGHT	49. VOLUME	50. AVERAGE POWER	51. STANDBY POWER	52. PEAK POWER	53. MTBF
29 LB		90 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
		APPROX 2 HOURS/DAY

62. TELEMETRY REQUIREMENTS

2 KHZ INFORMATION BANDWIDTH

63. ADVANTAGES AND LIMITATIONS

MORE SENSITIVE TO SMALL SIGNALS THAN ATS 1 TRANSPONDER

64. 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.

65. HISTORICAL REMARKS

SIMILAR TO ATS 1 WEFAX.

C

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Spin-Scan Cloud-Cover Camera - SSCC
VHF Transponder - VTRAN
Weather Facsimile Experiment - WEFAX

ATS 3

Image-Dissector Camera System - IDCS
Microwave Transponder - MTRAN
Spin-Scan Cloud-Cover Camera - SSCC
Omega Position-And-Location Equipment Experiment - OPLE
VHF Transponder - VTRAN
Weather Facsimile Experiment - WEFAX

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Day/Night Camera System - DNCS

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Position Location and Aircraft Communications - PLACE
Radio Frequency Interference Measurement - RFIM
Satellite Radio Beacon Experiment - SRBE
Ten-Point-Six Micron Laser Experiment - IRLAS
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ESSA 2

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ESSA 3

Advanced Vidicon Camera System - AVCS
Low-Resolution Infrared Radiometer - LRIR

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Automatic Picture-Transmission System - APT

ESSA 5

Advanced Vidicon Camera System - AVCS
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ESSA 6

Automatic Picture-Transmission System - APT

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ESSA 8

Automatic Picture-Transmission System - APT

ESSA 9

Advanced Vidicon Camera System - AVCS
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NIMBUS 1

Automatic Picture-Transmission System - APT
Advanced Vidicon Camera System - AVCS
High-Resolution Infrared Radiometer - HRIR

NIMBUS 2

Automatic Picture-Transmission System - APT
Advanced Vidicon Camera System - AVCS
High-Resolution Infrared Radiometer - HRIR
Medium-Resolution Infrared Radiometer - MRIR

NIMBUS 3

High-Resolution Infrared Radiometer - HRIR
Image-Dissector Camera System - IDCS
Infrared Interferometer/Spectrometer - IRIS
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Infrared Interferometer/Spectrometer - IRIS
Interrogation, Recording, and Location Systems - IRLS
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- Medium-Resolution Radiometer - MRR
- Vidicon Camera System - VCSN
- Vidicon Camera System - VCSW

TIROS 3

- Low-Resolution Nonscanning Radiometer - LRNR
- Low-Resolution Omnidirectional Radiometer - LROR
- Medium-Resolution Radiometer - MRR
- Vidicon Camera System - VCSW

TIROS 4

- Low-Resolution Nonscanning Radiometer - LRNR
- Low-Resolution Omnidirectional Radiometer - LROR
- Medium-Resolution Radiometer - MRR
- Vidicon Camera System - VCSM
- Vidicon Camera System - VCSW

TIROS 5

- Vidicon Camera System - VCSM
- Vidicon Camera System - VCSW

TIROS 6

- Vidicon Camera System - VCSM
- Vidicon Camera System - VCSW

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- Electron Temperature Probe - ETP
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TIROS 10

Vidicon Camera System - VCSW

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