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SUBJECT: J-3 SYSTEM HANDBOOK

The J-3 System Handbook has been prepared by A/P at the request of the Customer. It was written primarily for the various users of the photography, hence the description of the hardware is somewhat cursory.

Additional copies of the handbook may be obtained from the Performance Evaluation section.

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CORONA

J-3 SYSTEM HANDBOOK

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J-3 SYSTEM HANDBOOK

SECTION I

INTRODUCTION

The J-3 System Handbook has been prepared to provide a general summary of the camera characteristics. The design and functions of the reconnaissance system that are directly related to the acquisition of the photographic product are presented. The camera formats and recorded auxiliary data are included.

The J-3 system is expected to be operational in mid 1967. There will undoubtedly be design modifications that will negate some of the information in this handbook. Revisions will be furnished to maintain the usefulness of this publication.

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SECTION II

J-3 SYSTEM DESCRIPTION

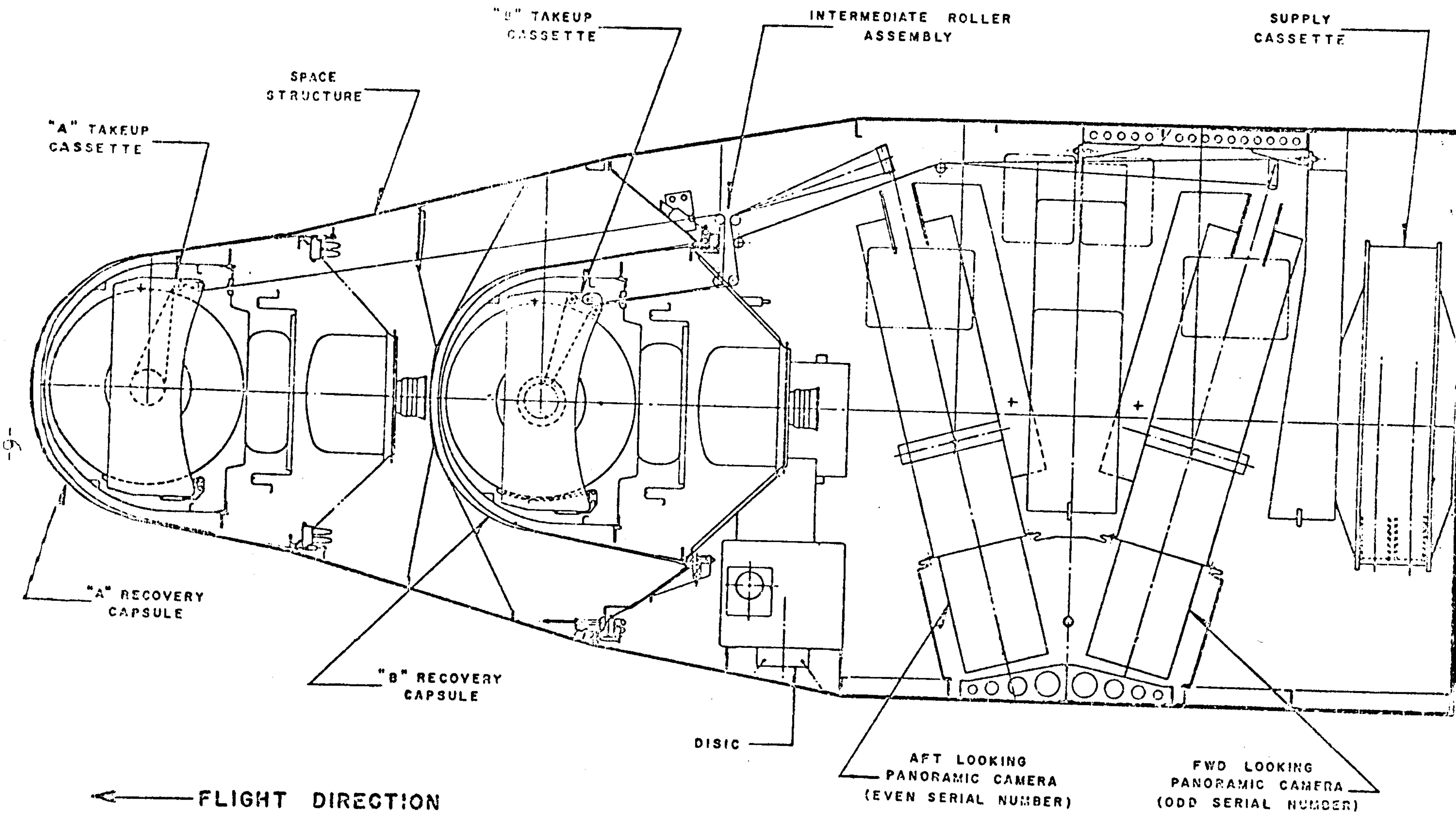
The major subsystems of the J-3 system are a panoramic camera, a DISIC (Double Improved Stellar-Index Camera) camera, a space structure and two recovery capsules. The panoramic camera subsystem consists of two panoramic cameras mounted in a 30° convergent stereoscope configuration, horizon cameras, a film supply cassette, and film take-up cassettes. The arrangement of these items within the space structure is shown in Figure 2.1.

A general summary of the system flight parameters is tabulated below.

J-3 FLIGHT PARAMETERS

Parameter	Design Range	Nominal Range
Active lifetime	14 days	
Camera operating altitude	80-200 N.M.	80-120 N.M.
Period	88-91.5 Minutes	
Perigee altitude	80-110 N.M.	
Inclination	60°-110°	80-97°
Perigee location	20°-60° No. Lat. Descending	
Beta angles	+65° to -65°	
Re-entry time-first capsule	1 to 10 days	6-7 days
Re-entry time-second capsule	2 to 14 days	14 days

The spatial position of the camera station can be determined to an accuracy of 1200 feet intrack, 600 feet crosstrack and 600 feet in altitude.



J-3 SYSTEM INBOARD PROFILE

Figure 2-1

The general role of the J-3 System is to provide stereoscopic photographic reconnaissance from a satellite. More specifically, the J-3 System has a dual purpose role in reconnaissance; namely, (1) intelligence acquisition, and (2) provisions to enable cartographic and geodetic evaluation of the photography and image points of interest.

The fundamental purpose of the J-3 System is to provide extensive stereoscopic photographic coverage of the ground with sufficient detail to allow a photointerpreter to recognize, evaluate, and monitor selected targets. Consequently, the J-3 System contains certain features which are designed specifically towards this end. First, the camera uses a high acuity, diffraction limited lens in such a way as to take advantage of the high resolution available over a narrow field angle. Secondly, auxiliary horizon recording cameras are mounted in a fixed relationship to the panormaic camera to provide an expeditious means for determining vehicle roll and pitch. A time reference system is provided which allows recovery of the time at which any point in the photographic format was recorded and also the time relationship of horizon optics exposure to panoramic exposure.

The secondary purpose of the J-3 System is to provide photogrammetric control data having the required geometric accuracy to assist the cartographer in constructing accurate terrain maps from the photography obtained by the system. Of equal importance is the ability to assign accurate geodetic coordinates to the maps so constructed.

For cartographic purposes it is essential to establish the geometric relationship between points on the film format and corresponding ground points. In order to accomplish this, it is necessary to calibrate the internal geometry of the camera. This involves the use of special equipment in pre-flight testing of the system and special data reduction techniques. The calibration information obtained from the tests is supplied to the cartographic community. Additional data is recorded on the film during in-flight photography. This data permits the correlation of the photography with the previously obtained calibration information. Thus, for every point on the film, it is expected that the cartographer can determine two angles, alpha (across-track or scanning angle), and beta (along-track angle), with an rms accuracy of 4 arc-seconds each.

SECTION III

PANORAMIC CAMERA SUBSYSTEM

Camera Description

The complete J-3 Panoramic Camera Subsystem consists of the following:

1. Two identical, 24-inch focal length, f/3.5, panoramic cameras, each having two integrated 55- millimeter focal length, f/6.3 horizon optics.

2. One auxiliary structure (supports both panoramic cameras and the electronics packages to form the so-called camera module).

3. One supply cassette.

4. One supply support structure.

5. Two take up cassettes.

6. One intermediate roller assembly.

The panoramic cameras are positioned on the auxiliary structure in a V-configuration to provide a 30-degree stereo angle. The auxiliary structure is three point mounted to the vehicle so that the even serial numbered camera is located forward and views toward the rear (aft-looking), and the odd serial numbered camera is located aft and views forward (forward-looking). The auxiliary structure also provides the mounting surface for the system's electronic packages. The supply cassette, which contains the total film supply for both cameras, is located aft of the camera module. The supply cassette is fastened to its support structure which is, in turn, three-point mounted to the vehicle. Take-up A, located in recovery vehicle RV-1, and take-up B, located in RV-2, each take up half of the film of both cameras. The intermediate roller assembly is attached to the vehicle between take-up B and the camera module.

The system is basically designed to use 2.5-mil base, 3.0-mil thick, 70 millimeter, EK 3404 film. The supply cassette contains two 38-inch diameter spools, each capable of storing 16,000 feet of film. Each of the two take-up A spools is capable of storing 8000 feet, and each take-up B spool is capable of storing 7750 feet of film. The system's total film capacity, therefore, is limited by take-up B to 31,500 feet.

The system may be operated with another emulsion type separately or in combination with 3404. These other film types, thickness, approximate aerial exposure index and sensitivity range are listed below.

Type	Thickness	Speed	Sensitivity
SO-380	0.0020"	3.6	Panchromatic
SO-121	0.0036"	16	Color
SO-340	0.0045"	250	Panchromatic
SO-230	0.0030"	6	Panchromatic
SO-180	0.0036"	16	Infra-red
SO-166	0.0045"	8000	Panchromatic

A summary of the general configuration and operational characteristics are included in Table 3-1.

Camera Operation

The panoramic cameras are independent and similar but are not interchangeable. Each camera consists of its own machined frame upon which most of the camera components are mounted. Because some camera components are attached to the auxiliary structure, the structure must be considered as an integral part of the panoramic camera.

The primary components of the panoramic camera, as shown in the functional schematic in Figure 3-1, are: (1) drive system, (2) lens, (3) scan head assembly, (4) drum, (5) film transport mechanisms, (6) FMC mechanism, (7) panoramic geometry system, and (8) the horizon optics. The actions of these components are related and timed through a system of belts and pulleys and special-function gear packages, all of which are driven from a single camera drive motor.

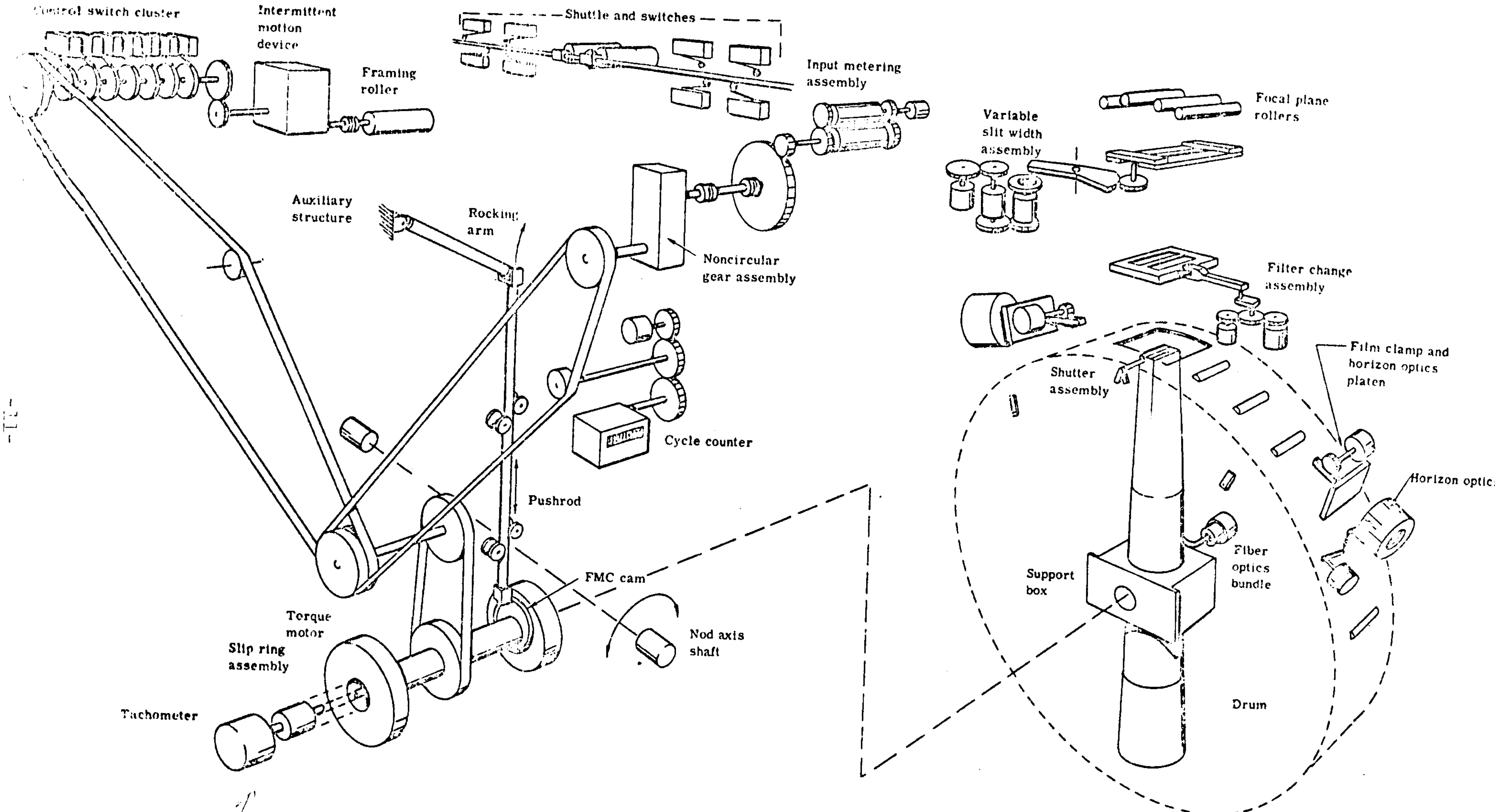
The 24-inch focal-length lens is a Petzval design consisting of five elements mounted within a cast magnesium cell. A sixth element, the field flattener, and an exposure/filter device are mounted on the end of a titanium tail cone which is, in turn, secured to the lens cell at the nodal point.

PANORAMIC CAMERA SUBSYSTEM PARAMETERS

PARAMETER	PANORAMIC CAMERAS (2)	HORIZON CAMERAS (4)
Lens	24" f/3.5	55mm f/6.3
T/Number	T/3.85	
Resolution (3404 Emulsion)	110 L/MM C = 0.3	- - -
Usable Format	29.323" x 2.147"	2.1" x 0.9"
Shutter Type	Slit with Capping Shutter 0.134" to 0.340" Wide	Between the Lens
Angular Coverage	$70^{\circ} \times 5.12^{\circ}$	$52^{\circ} \times 24^{\circ}$
Nominal Exposure Time	1/400 Second (Variable)	1/100 Second (Fixed)
Filter	Variable - 2 Position Commandable	Wratten 25 Plus Commandable Attenuator
Fiducials	Rail Holes	5 Each
Cycle Period	1.5 to 4.2 Seconds/Cycle	Every Other Pan Frame
Endlap	7.6%	N/A
Data Recording	Time, Serial Number and Geometery Data	

TABLE 3-1

-10-



CAMERA FUNCTIONAL SCHEMATIC

Figure 3-1

The scan head assembly, which contains the slit width and filter change device and the focal plane rollers, is mounted on the end of the lens cone. This device consists of a bidirectional, four-position slit width changer and a two-position filter changer shown in Figure 3-2. A slit width failsafe mode or nominal slit width position is also provided. The slit blades are driven by a servo motor which is clutched to a dual potentiometer. A nomograph for determining camera exposure time is shown in Figure 3-3. The filter and a dual potentiometer are driven by a stepper motor. During the exposure portion of the scan, the focal plane rollers lift the film from the guide rails into the exact focal plane.

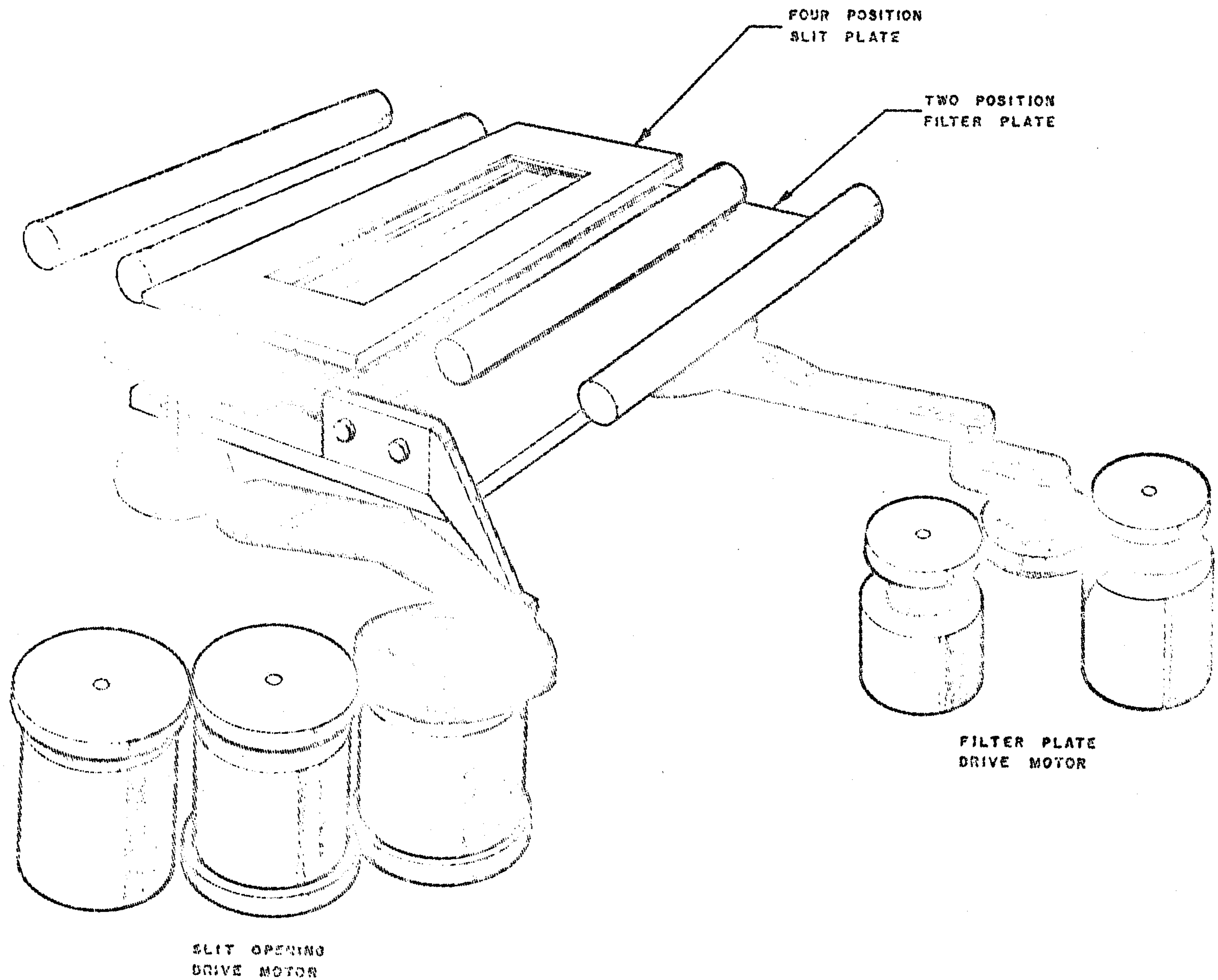
In order to prevent light from entering the vehicle compartment through the vehicle/camera interface, a drum rotates with the lens within a network of non-rotating light shields that nod with the drum. The drum itself is light-tight except for the clear aperture end and a smaller opening for the scan head access cover. Two formed pieces of sheet metal, which are attached to the drum around its periphery, rotate inside a labryinth preventing light from entering alongside the drum. The inside diameter of the light shields are slightly larger than the diameter of the drum, and the shields encompass the drum over a sufficient portion of the circumference to prevent light from passing around the drum itself.

The drum assembly also serves as a thermal shield for the lens when the camera is inoperative. Furthermore, a series of rollers, located around the circumference of the drum and placed parallel to the lens rotation axis, revolve with the drum just beneath the film guide rails to prevent film from being pulled through the rails. These rollers do not contact the film under normal operation.

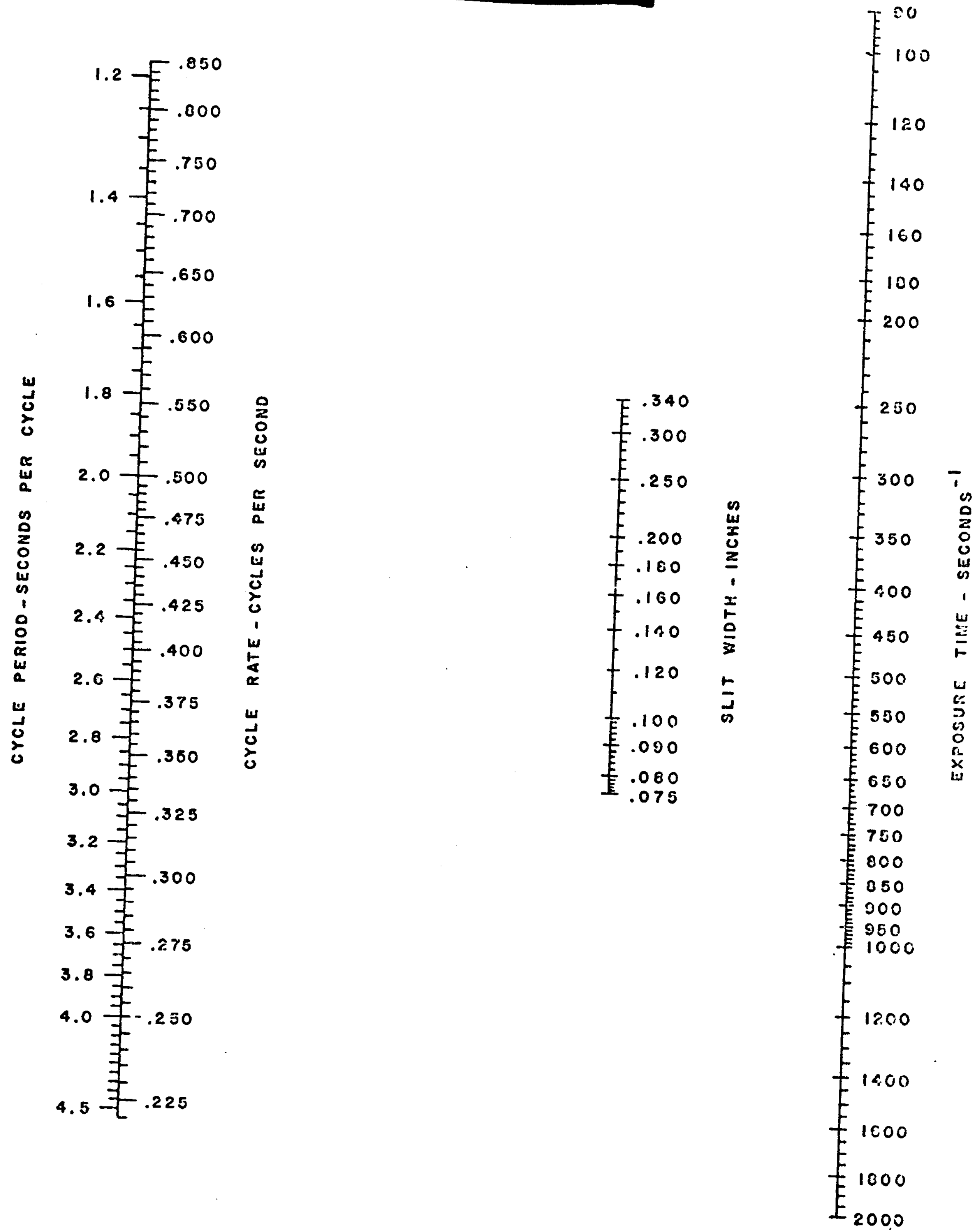
The camera film transport system, shown schematically in Figure 3-4, comprises an input metering roller which is geared through a 99/101-per cent clutch to provide continuous input metering at a nominal rate. Film guide rails guide the film over the 70-degree format and film clamps located at either side of the format are actuated during exposure. A frame metering roller pulls one frame of exposed film out of the format area during the nonexposure portion of the cycle. A shuttle mechanism stores the extra length of film arising from continuous film input and output and intermittent frame metering. The shuttle also is used to control the 99/101 per cent clutch. The complete film path is shown in Figure 3-5.

Each camera contains its own FMC mechanism. The FMC mechanism is comprised of a cam, which is driven by the camera drive motor, and a four-bar linkage which is driven by the cam. The linkage is fixed at one point such that the action of the cam against the linkage causes the cameras to rock in the vehicle pitch axis. The FMC cam has been designed to produce a 7.6 percent endlap in each panoramic frame with exact FMC correction.

[redacted]

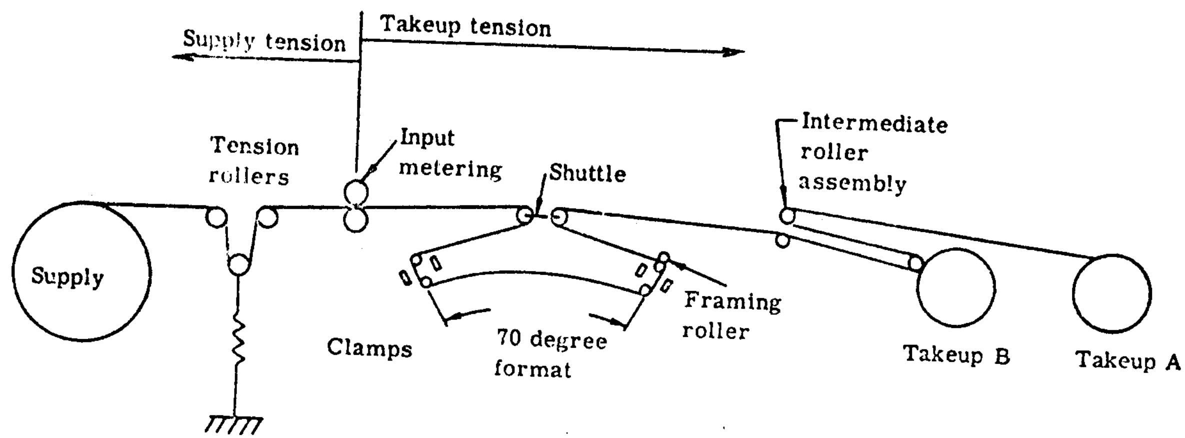


SLIT AND FILTER CONTROL
Figure 3-2



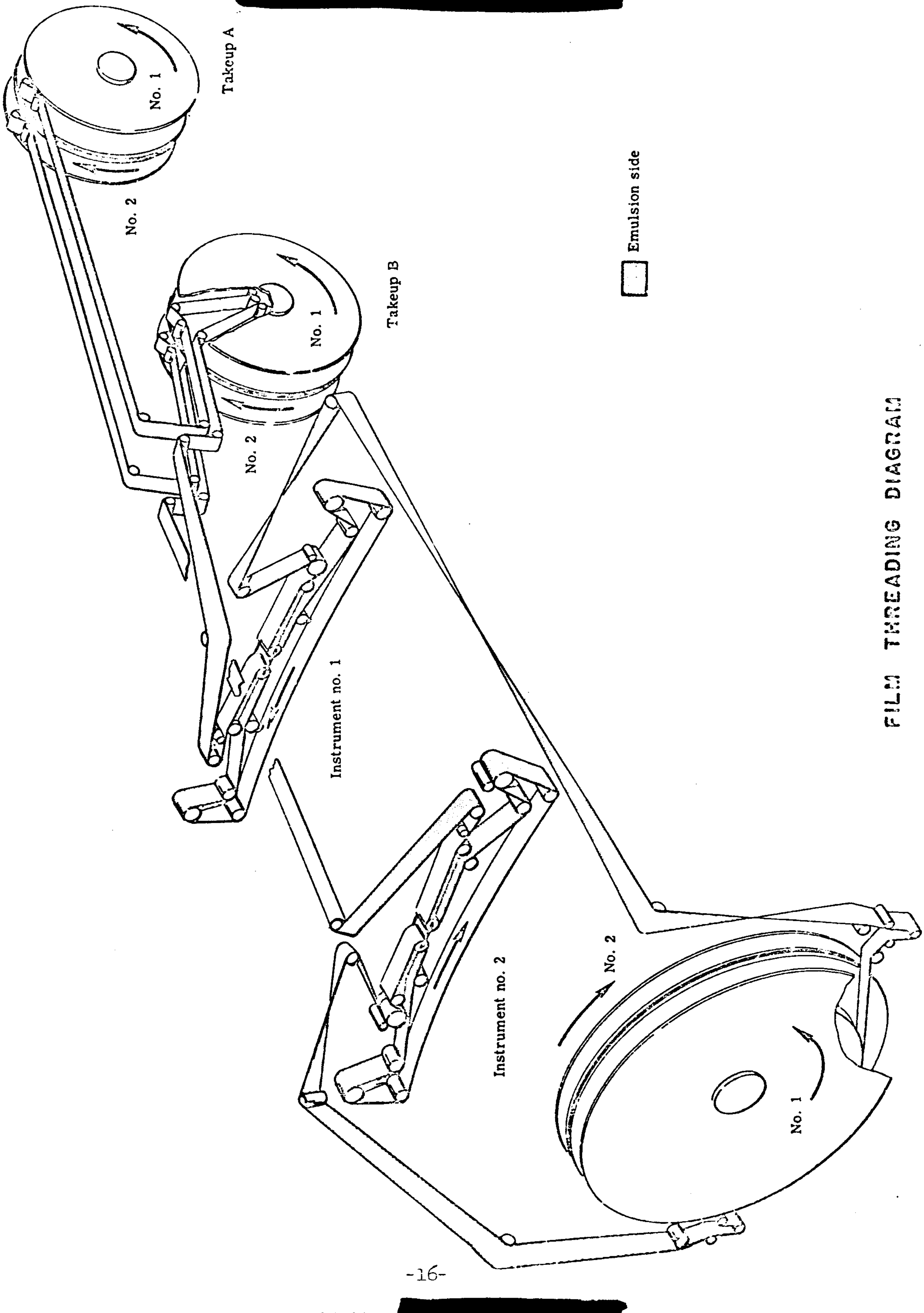
SYSTEM EXPOSURE TIME CONVERSION

Figure 3-3



FILM TRANSPORT SCHEMATIC

Figure 3-4



FILM THREADING DIAGRAM

Figure 3-5

Each panoramic camera contains two horizon camera assemblies that allow the photointerpreter to quickly determine the pitch and roll attitude of the panoramic camera during exposure. The horizon camera consists of a 55-millimeter, f/6.3 lens, a between-the-lens leaf shutter, a shutter-trip solenoid, an attenuator change mechanism, and an assembly housing. The horizon camera assemblies are mounted on each end of the film transport bridge. This facilitates the sharing of a common film supply and path with the panoramic camera. The optical axes of the horizon lenses are nominally,but not exactly, coplaner with the optical axis of the panoramic camera. The horizon cameras operate with every other panoramic camera frame.

The horizon camera uses an integral filter equivalent to a Wratten No. 25. The lens provides a format of 2.1 by 0.9 inches. The corresponding half angles are 26 and 12 degrees, respectively.

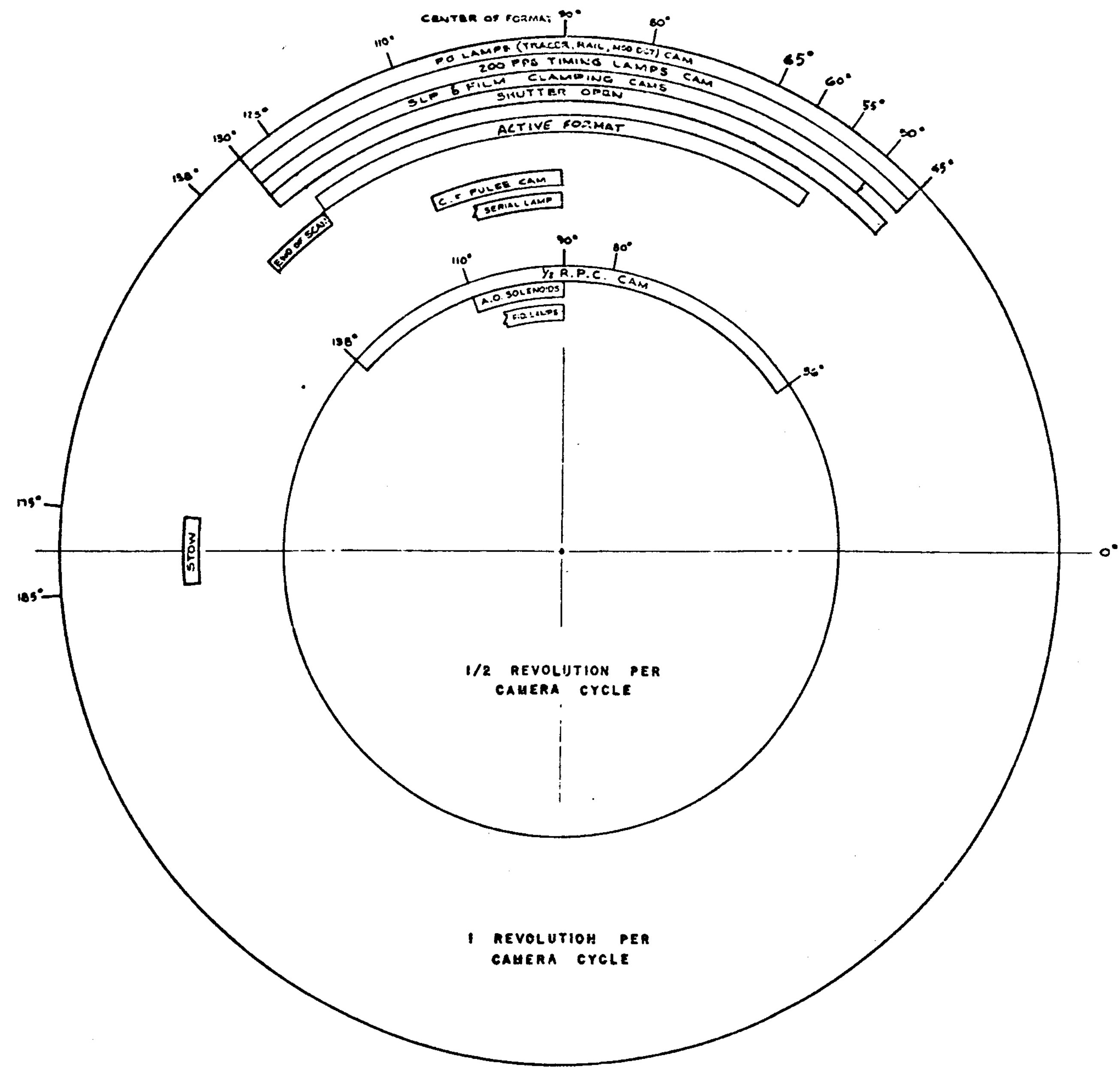
The horizon camera housing provides a support structure for the lens, shutter mechanism, lens cone, lens hood, and filter change mechanism. The filter change mechanism, mounted in front of the lens, consists of a sliding filter on a track, a drive motor, and connecting linkage. An attenuating filter may be slid in front of the lens when films faster than the basic 3404 are used.

The relationship of the exposure functions within the camera are controlled by series of cams. The one revolution per cycle cam operates the panoramic camera functions while the one-half revolution per cycle cam controls the horizon cameras. The sequence of events is shown in Figure 3-6.

Camera Format

A sketch of the camera format with associated data is shown in Figure 3-7 and the SLP data block format is shown in Figure 3-8. The relationship of the camera formats to the ground scene is shown in Figure 3-9. The usable pictorial area of the panoramic camera photography is 29.323 inches along the film major axis and, as shown, 2.147 inches across the film. The coverage associated with this format size is listed in Table 3-2 for various altitudes.

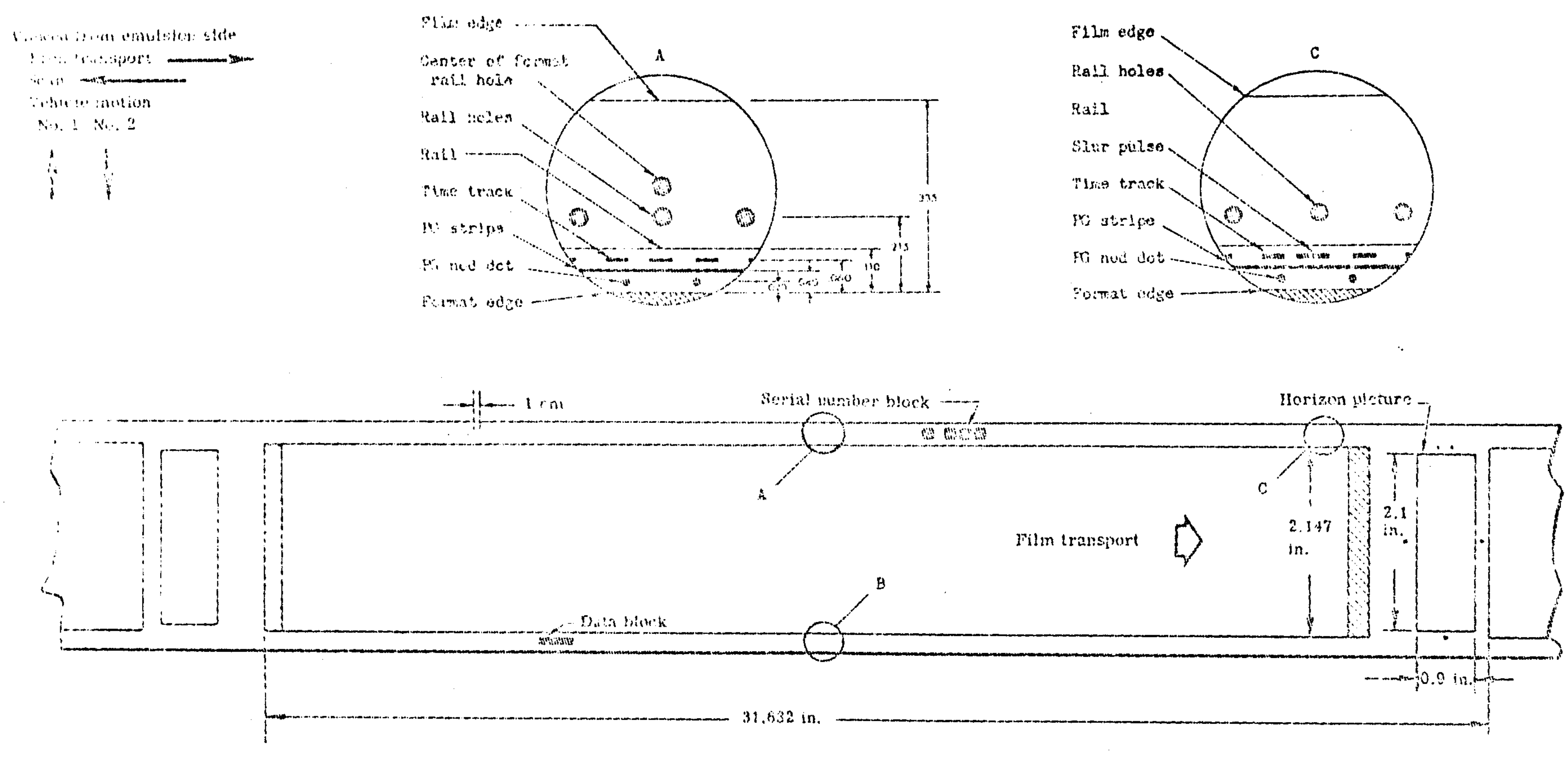
The photographic scale can be determined by using the nomograph in Figure 3-10. This chart includes the scale variation with departure from the center of the format. The center of format is denoted by a dual rail hole as shown in enlargements "A" and "B" on Figure 3-7.

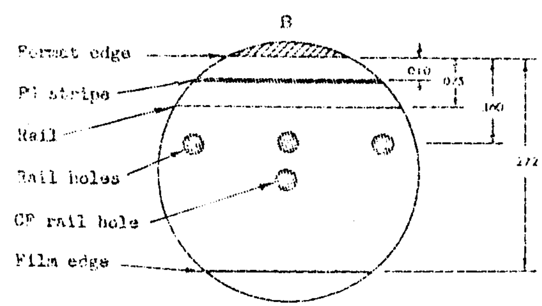


TIMING DIAGRAM

FIGURE 3-6

[redacted]





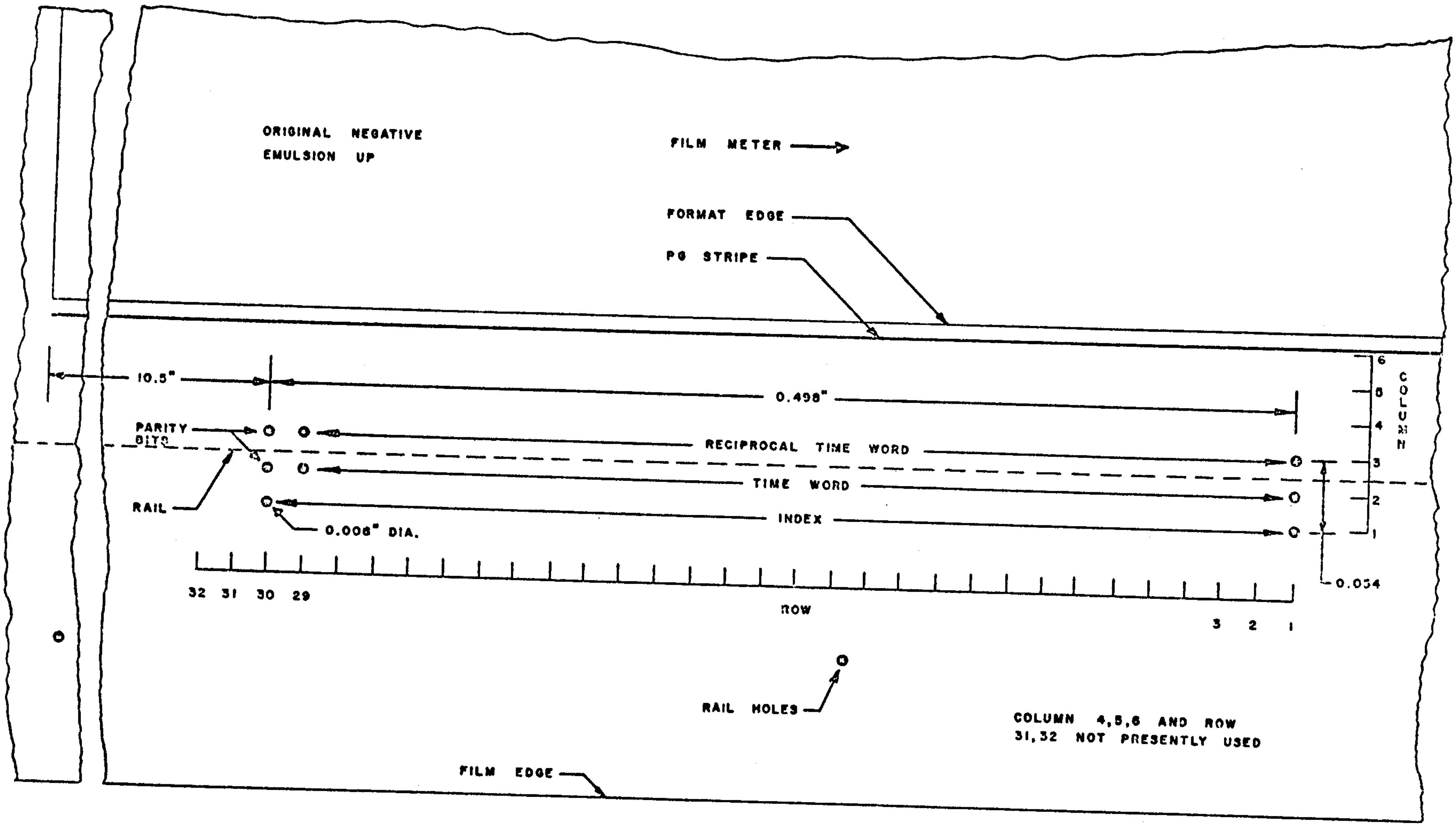
DATA	SIZE
R.O. Fiducial	0.005 dia
Rail Hole	75 microns dia
PG strips	25 microns wide
PG nod dot	50 microns dia
Time track	0.005 x 0.045
SLP time bits	0.007 dia

All dimensions are inches unless otherwise stated. All values are nominal with no stated tolerance

ORIGINAL NEGATIVE FORMAT DRAWING

Figure 3-7

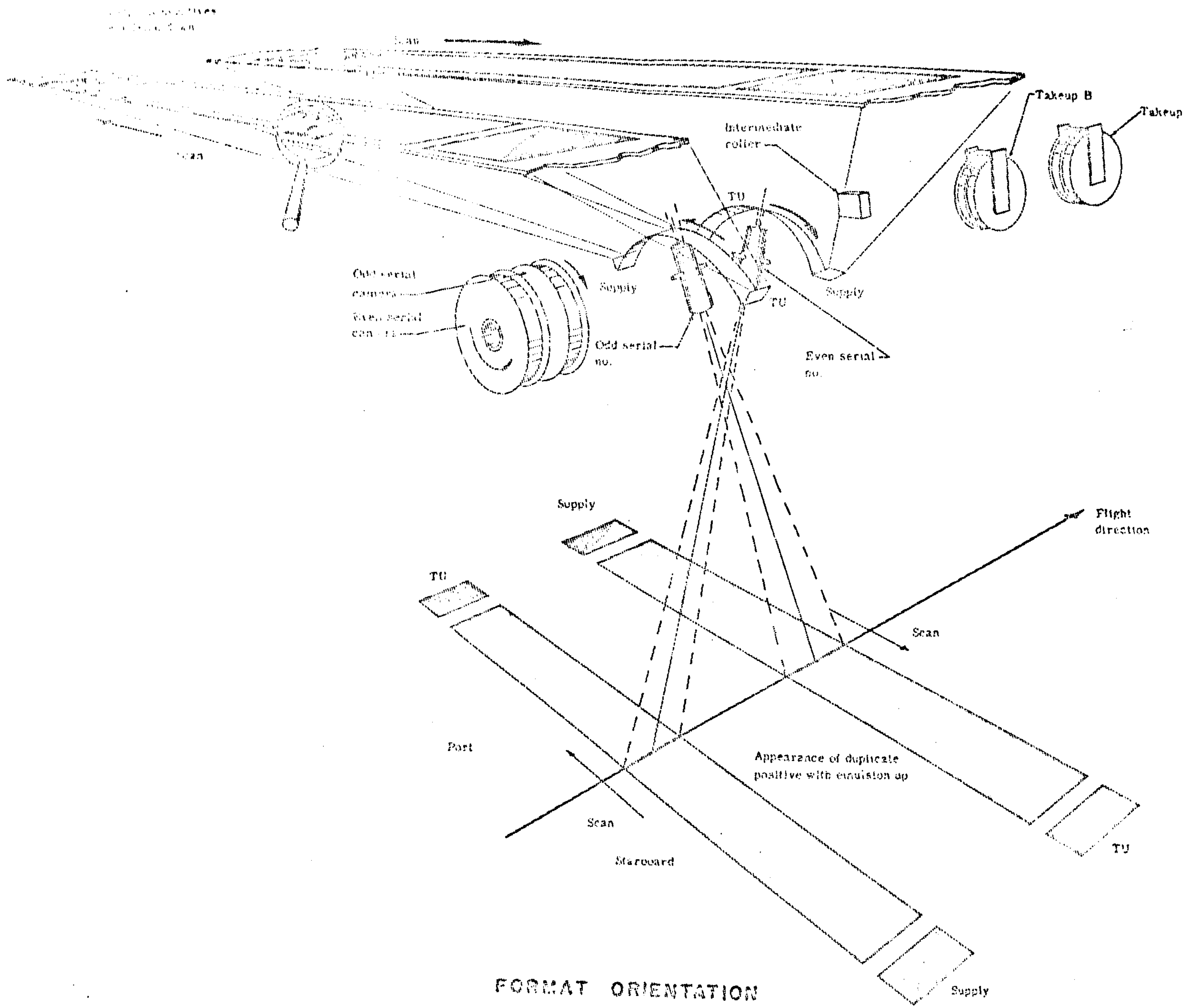
[redacted]



DATA BLOCK FORMAT

Figure 3-8

[redacted]



FORMAT ORIENTATION

Figure 3-9

[redacted]

PANORAMIC CAMERA SUBSYSTEM COVERAGE

(3.0 MIL BASE FILM)

Altitude (N.M.)	80	85	90	95	100	105	110	115	120
Frame Forward Cover (N.M.)	7.7	8.2	8.6	9.1	9.6	10.1	10.6	11.0	11.5
Frame Width Cover (N.M.)	116.0	123.2	130.5	137.7	145.0	152.2	159.5	166.7	174.0
Area Per Frame (Square N.M. x 10^2)	8.9	10.0	11.3	12.5	13.9	15.3	16.8	18.4	20.0
Mission Stereo Cover (Square N.M. x 10^6)	4.9	5.6	6.2	7.0	7.7	8.5	9.3	10.2	11.1

Table 3-2

SCALE CONVERSION

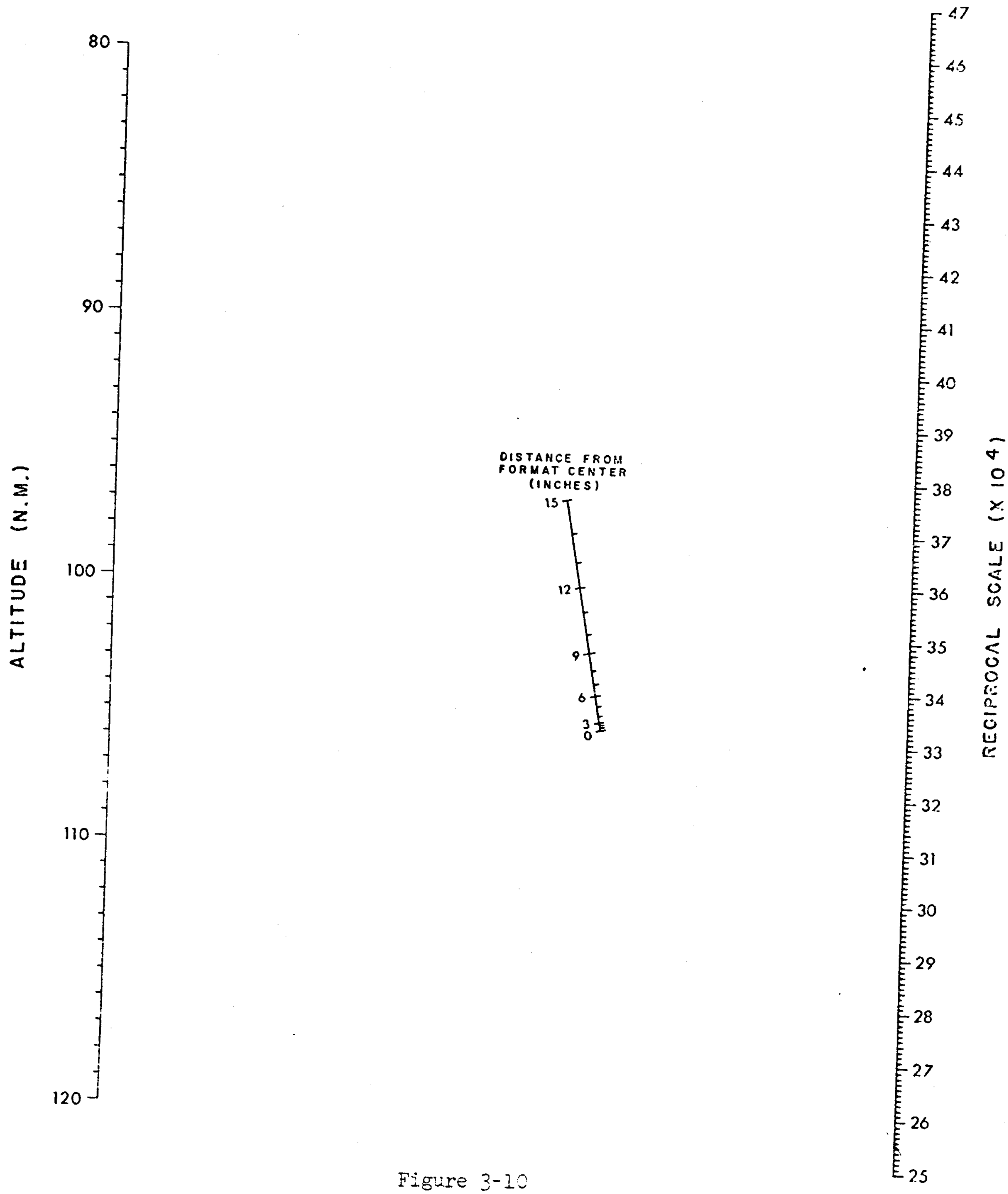


Figure 3-10

The horizon camera format includes five fiducials which register as 0.006-inch diameter dots. These dots are formed by 1.5-volt incandescent lamps which contact prints through small holes in the format frame when the panoramic camera is in the center of format. The fiducials are nominally positioned to provide the basis for a coordinate reference system for calibration. The intersection of imaginary lines joining opposite fiducials represents the origin of the coordinate system. (This intersection does not represent a photogrammetric point.)

Panoramic Geometry

The camera incorporates the means by which a calibration framework can be developed that allows the panoramic photography to be utilized for cartographic purposes. The components of this panoramic geometry framework internal to the camera are: (1) a series of holes spaced at one centimeter intervals along each film guide rail, (2) a pair of lamps fastened rigidly to the upper end of the lens scan arm which produce traces on either side of the format and which represent the locus of the path of the principle axis of the lens, (3) a nod angle to scan angle calibration system which, by means of a xenon flash triggered by an optical encoder mounted on the nod axis, images a series of small dots along the edge of the format, and (4) a series of timing pulses also imaged on the edge of the format to provide a time reference. The location of this data on the film is shown in Figure 3-5.

To obtain the initial calibration of each camera, a grid which has been very accurately scribed onto a thick glass platen is exposed onto a length of film. This film is then programmed through the camera and the above noted data is double exposed onto the grid. An accounting is made for the distortions due to the printing of the calibration grid, dynamics within the camera system, and developing processes. After these are factored out, it is possible to calibrate the rail holes through the grid intersections in such a way as to allow the use of the rail holes as the basic framework actual operation for the determination of the Alpha (scan) angle (since the grid is not a permanent part of the camera). When their position is related to the xenon flash nod-to-scan calibration dots, the relationships of nod to scan angle can be determined. The Beta angle can best be determined by a direct measurement from the PG stripes which define the principle point of the lens at any instant in time.

To make proper use of the material for cartographic purposes, it is also necessary to know the attitude of the vehicle during exposure. This information is provided by the DISIC, as described in Section IV, which simultaneously records stellar and terrestrial imagery and therefore allows for a determination of the vehicle attitude at that instant. In addition to the internal geometry for each camera, it is necessary to know the relative orientation of one panoramic camera to the other, as mounted in the vehicle. This will be established after vehicle installation by means of an external array of calibration collimators.

The panoramic geometry components record a sufficient amount of accurate data on each panoramic frame to enable the cartographic community to determine, at every point on the frame, the following parameters:

1. Alpha (scanning) and Beta (along-track) angles with an accuracy of 4 arc-seconds, 1 Sigma (rms).
2. The absolute time of exposure with an accuracy of 2.5 milliseconds, 3 sigma. (This is necessary since all the images in the panoramic format are not photographed simultaneously.)
3. The time of exposure relative to another specific point on the format with an accuracy of 1 millisecond, 3 sigma.
4. The change in the nod angle of the camera, at the time of exposure of the image point, from a predetermined nod angle with an accuracy of 4 arc-seconds, 1 sigma.

These parameters can be obtained for each image point by making linear measurements between the image point and the data which is recorded at the edge of the film adjacent to the format. A row of rail hole images and solid traces are recorded along the length of the format (scanning direction) at one edge of the film. At the other edge of the film, a row of rail hole images, a solid trace, a row of timing marks, and a row of nod angle dots are recorded.

The rail hole images are round spots about 75 microns in diameter. They are the images of 0.0015-inch diameter holes in the rails. The rails support the edges of the film on an arc of 70 degrees. There are 73 holes in each rail spaced about 1 degree apart angularly and approximately 1 centimeter apart linearly.

The rail holes are calibrated metrically so that their position is known to about 6 microns, 1 sigma, (4 microns in each of two orthogonal directions), so that this information, when used in conjunction with rail diameter measurements, allows determination of the Alpha angle (scan angle) of each hole. The accuracies of the rail hole calibration vary slightly between cameras, but are specified in the calibration report provided with each camera.

In each rail, the rail holes are exposed one at a time as the lens rotates about its nodal point. The rail lamps are positioned in such a way that the rail holes and the ground images are exposed simultaneously. The zero scan angle is set arbitrarily by an additional rail hole at the center of each of the rails.

The solid traces, usually referred to as the panoramic geometry traces, are useful in locating the principle point of the lens. The position of the principle point must be known so that linear measurements in the x-direction of the film (along-track) can be correctly converted to Beta angles. The distances of the two light spots which produce the solid traces from the principle point will be measured and given as x, y, co-ordinates. The principle point will have (0.0) coordinates. The panoramic geometry traces are about 25 microns wide. The x, y coordinates of the two light spots that produce the solid traces will be given with respect to the principal axis from measurements made on an optical bench.

The nod dots are round spots about 50 microns in diameter. They are produced by a separate subsystem consisting of an accurate optical encoder, electronic circuits, a xenon flashtube, two sections of optical fiber bundles, a rotating optical coupling, and a lens.

An optical encoder is mounted on the nod shaft of the camera to measure the nod angle. At certain fixed nod angle positions (every 19.78 arc-seconds), the encoder and its associated electronics generate electrical pulses. These pulses are introduced to a count-down circuit one pulse every 39.55 arc-seconds of nod shaft rotation. These remaining pulses trigger the xenon flashtube which flashes for 2 microseconds in response to each pulse. The light of the xenon flahstube is piped by the fiber optics bundles through the rotary optical coupling to the scan head, where the fiber bundle is masked except for a very small hole. The light emerges from this hole and is projected by a small lens onto the film.

In this manner, dots which can be identified with definite nod angles are recorded on the film. The position of a nod dot along the film (y co-ordinate of a frame) depends on the location of the scan head with respect to the rails (in other words, the scan angle) when the xenon flashtube was triggered. This provides sufficient information to obtain the calibration of the nod versus the scan angle. The zero nod position is arbitrary, and it is defined by an additional nod dot generated by the zero reference output of the encoder.

The time marks are elongated spots 0.005 inch wide by 0.045 inch long. Their main purpose, as part of the scanning function, is to facilitate the determination of the time of exposure of the format. The time marks are generated by an accurate pulse generator (200 pulses per second) which triggers a neon tube. The light of the neon tube is focused on the film by the same lens which focuses the nod dots. The time marks permit the determination of the time difference between the exposures of two different points on the format with an accuracy of 1 millisecond (3sigma).

A vehicle clock provides the basic time reference for the system. This clock is interrogated at approximately the center of format. The absolute time of the next timing pulse is recorded in binary form on the previous frame by the SLP block. The timing mark, which occurs immediately after the clock has been interrogated, is purposely elongated so that it shows the relation between the time marks and absolute time. Thus, the absolute time at which a point on the format was exposed can be determined with an accuracy of 2.5 milliseconds (3 sigma).

Data Displays

In addition to the panoramic geometry display, certain other data appears on the film. The vehicle clock is read out to a semiconductor light pulse block (SLP) which exposes the time on the film in binary form. The binary spot size is about 0.007 inch in diameter. There are actually six columns of 32 bits available, but only three columns of 30 binary bits are used as shown in Figure 3-6. The columns are parallel to the edge of the film and are read from left to right as seen from the side of the film away from the emulsion when the SLP is on the edge of the film nearest the viewer. The column furtherest from the film edge is column number one, and all 30 bits are illuminated to provide a registration for mechanical readout. Column two presents the time work in rows 1 through 29 with the 30th bit being the parity bit. Column three presents reciprocated time, again with the 30th bit being the parity bit.

To properly image the SLP, it is necessary to firmly clamp the film to the block during exposure. Since this is not possible in the film format area, the SLP block is located on the take-up side of the framing roller. This means that any time readout as seen on the film is associated with the following (next higher number) frame, or conversely, when ascertaining the time a particular frame was taken, it is necessary to look at the SLP read-out block on the previous or lower numbered frame.

Determination of the instant during scan when the time was recorded is made by noting the position of a smear pulse in the 200-cycle-per second timing marks. This is a variance on the J-1 technique where clock interrogate was referenced by a blanked pulse.

The camera serial number is exposed on the film margin opposite to the data block as shown in Figure 3-5. The serial number is located approximately 6.9" to the left of format center. A cross is exposed in this same margin at the initiation of camera operations. This cross is physically located adjacent to the camera serial number. The exposed image on the film can be located at any point along the film edge as is the case with J-1 systems.

The margin of the horizon camera format contains five fiducial hole images which are used to reference the position of the principal point of autocollimation of the horizon lens.

Camera Calibration

The panoramic camera lenses and horizon cameras are individually calibrated prior to being mounted on the panoramic camera. This individual calibration consists of determing the principal point of autocollimation and the equivalent focal length, and checking the lens distortion characteristics. Subsequent to this, each camera system is calibrated to determine the position of the horizontal cameras in relation to their respective panoramic camera lens. The accuracy of these calibrations is shown in Table 3-3.

PANORAMIC CAMERA CALIBRATION

COMPONENT	PARAMETER	CALIBRATION
Main Lens	Equivalent Focal Length	25 Microns
Main Lens	Radial Distortion	1 Micron
Main Lenses	Convergence	60 Arc Seconds
Horizon Optics	Equivalent Focal Length	25 Microns
Horizon Optics	Principle Point to Fiducial Intersection	10 Microns
All Lenses	Alignment	60 Arc Seconds

Table 3-3

SECTION IV

DISIC SUBSYSTEM

Camera Description

The J-3 System contains a cartographic frame camera which records terrain and stellar photography. The DISIC (Double Improved Stellar-Index Camera is comprised of three cameras; one downward looking terrain camera and two stellar cameras whose axes are 10° above the horizontal. The DISIC inboard profile and end view installation drawing are shown in Figure 4-1 and 4-2 respectively. A listing of the general camera design parameters is given in Table 4-1.

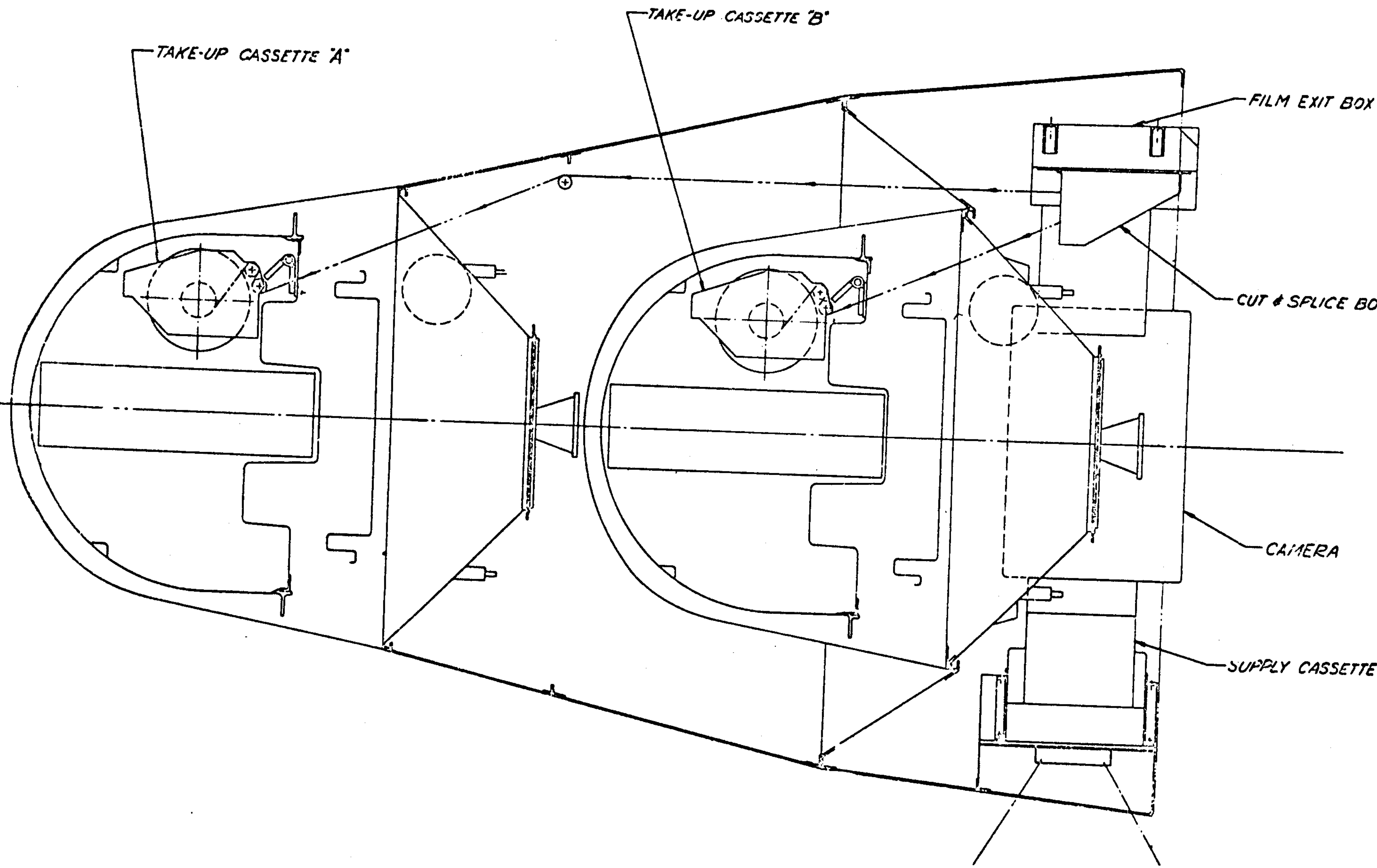
The DISIC subsystem is designed to operate in conjunction with the panoramic cameras, termed the slave mode, or to operate independently. The camera functions are controlled within the unit and are time phased rather than controlled from signals from the panoramic camera. There are therefore no indications on the panoramic film to show DISIC operations. All frame correlation is accomplished with the interpolation of the binary time words on the panoramic, terrain and stellar films. The mechanical block diagram of the DISIC is illustrated in Figure 4-3.

Camera Operation

The terrain camera is reset to operate at either 9.375 or 12.5 seconds per cycle based on planned camera altitude. The stellar camera cycle period is 3.125 seconds during slave operations (Mode 1) thus producing three stellar frames for each terrain frame at the 9.375 second period. When the DISIC is in the independent mode (Mode 2) the stellar camera operates once for each terrain exposure. The sequence of camera events is shown in Figure 4.4 for a typical 9.375 second terrain camera cycle period.

An exploded view of the functional schematic and film threading schematic of the camera is shown in Figure 4-6. All of the motions within the camera are produced by a single drive motor. Certain options have been incorporated into the design to increase operational flexibility and improve the photography. The capping shutter in either of the stellar cameras can be left in a capped position to avoid direct sunlight entering the camera. The exposure time of the terrain camera can be changed from 1/500 second for normal solar elevations to 1/250 second for low solar elevations. This mechanism is designed to fail safe in the 1/500 second position if failure occurs.

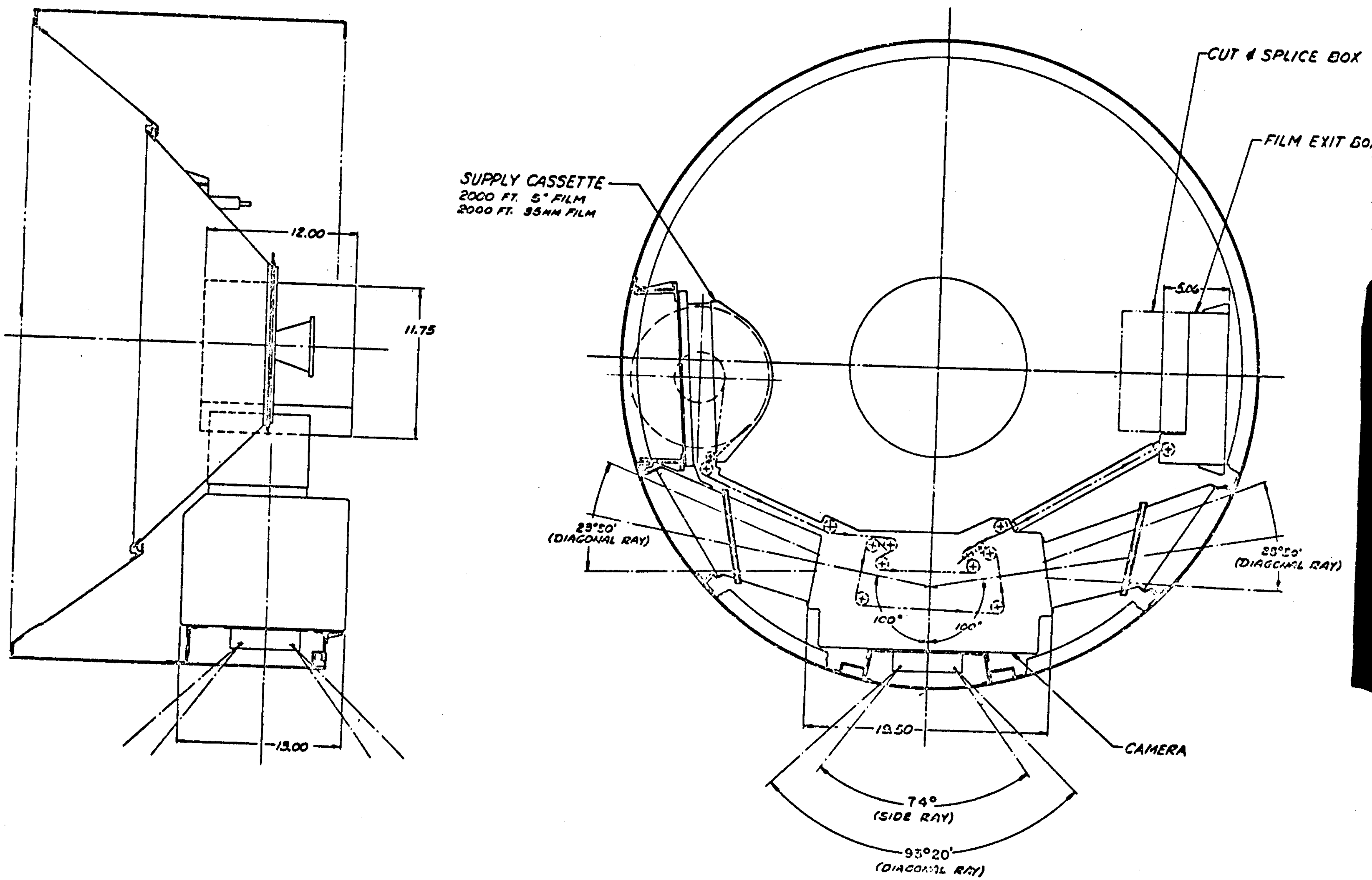
The DISIC contains two film paths; a 35mm stellar film and a 5 inch terrain film. The 35mm film passes through both stellar cameras and is metered such that the imagery from each camera is interlaced as shown in Figure 4-6. No alteration is made to the film metering when one of the capping shutters is closed.



DISIC INBOARD PROFILE

Figure 4-1

[redacted]



DISIC INSTALLATION-END VIEW

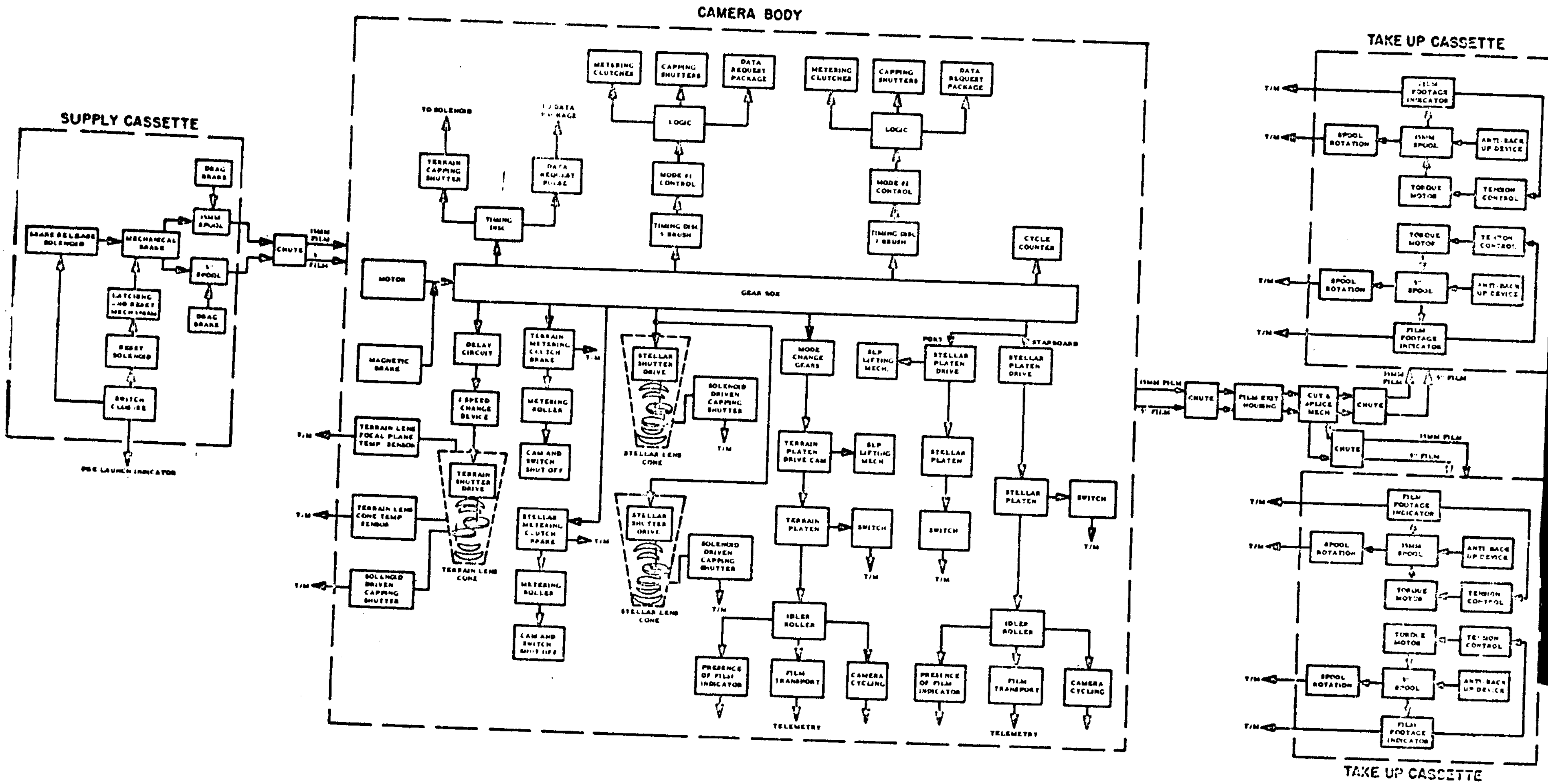
Figure 4-2

[redacted]

DISIC SYSTEM PARAMETERS

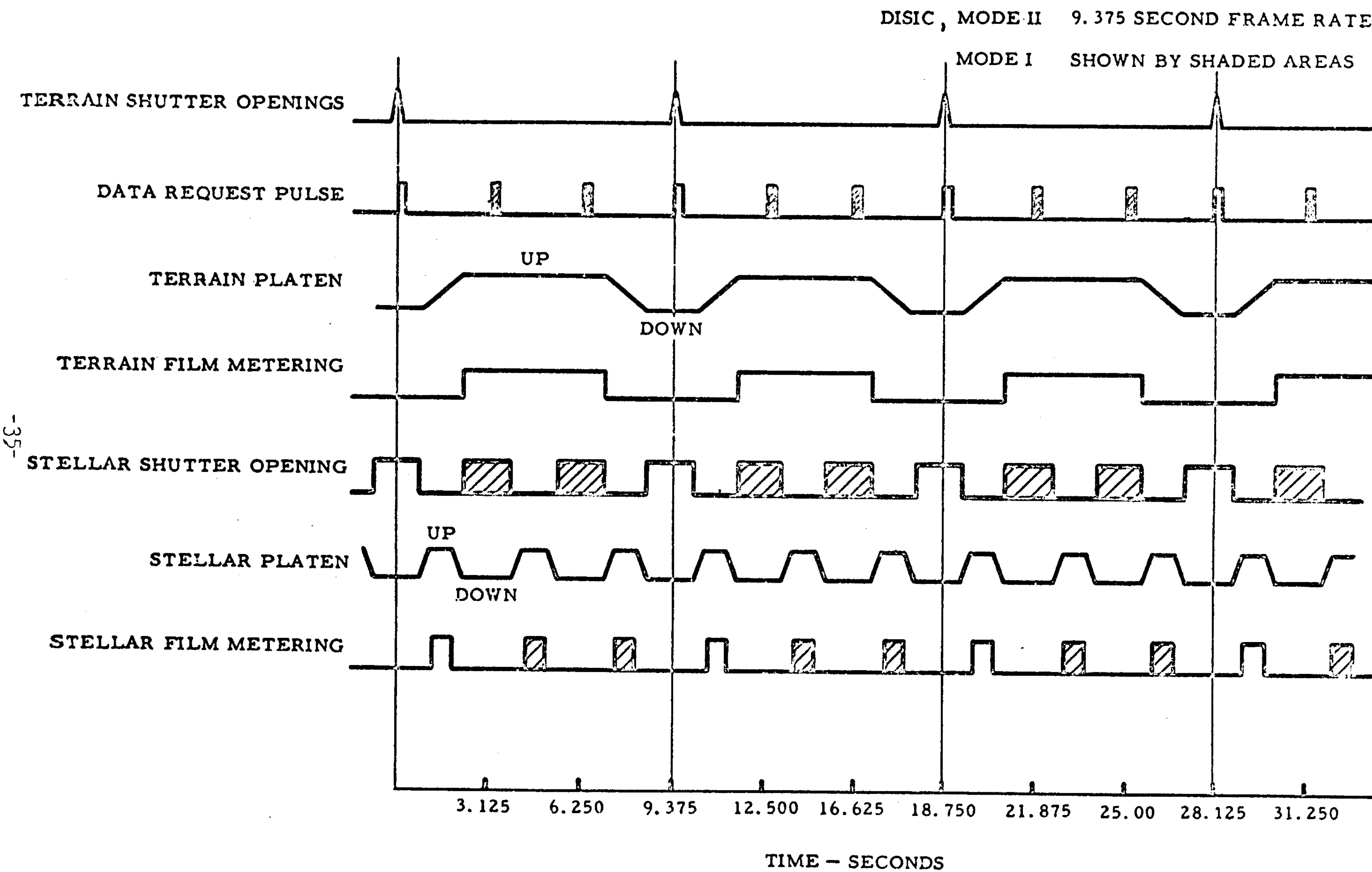
PARAMETER	TERRAIN CAMERA	STELLAR CAMERA (2)
Lens	3-Inch Ikogon	3-Inch Ikotar
Aperture	f/4.5	f/2.8
Static Lens Resolution (3400 Film)	60 L/MM AWAR, Contrast = 0.3 Wratten 12 Filter	80 L/MM AWAR, Contrast = 3.0 (3401 Film)
Film Format	4.5 Inches by 4.5 Inches	1.25 Dia. with Flats
Angular Coverage	74° by 74°	23-1/2°
Lens Distortion (Max.)	30 Microns (R) 5 Microns (T)	15 Microns (R) 5 Microns (T)
Film Flattening	By Glass Plate	By Glass Plate
Reseaux	2.5mm Spacing 10 Microns Max. Width	2.5mm spacing 10 Microns Max. Width
Natural Fiducials	1 Set of Four	1 Set of Four
Shutter Type	Rotary	Rotary
Selective Exposure Time	1/250 Second 1/500 Second	1.5 Seconds (Fixed)
Cycle Period	9.375 Seconds/Cycle 12.5 Seconds/Cycle	3.125 Seconds/Cycle (Mode 1) Same as Terrain (Mode 2)
Dual Stellar Operation	- - - -	Simultaneous or by Selection
Knee Angle		100°
Data Recording	Time & Camera Serial Number	Time & Lens Serial Number
Film Requirements	5-Inch by 2,000 Feet	35 mm by 2,000 Feet
Film Weight (2.5 Mil Base)	18.3	5.3 Pounds

TABLE 4-1



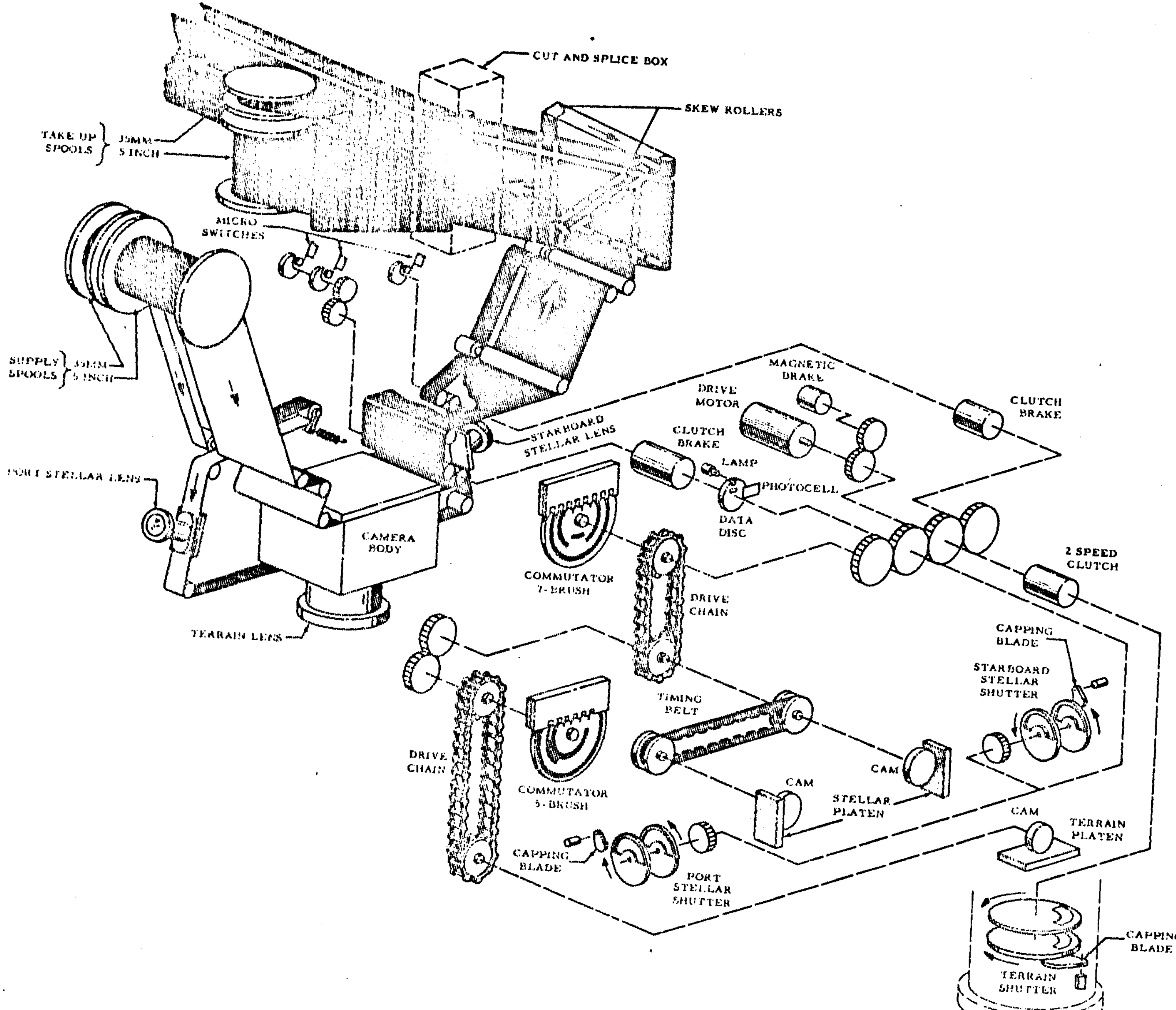
MECHANICAL BLOCK DIAGRAM

Figure 4-3



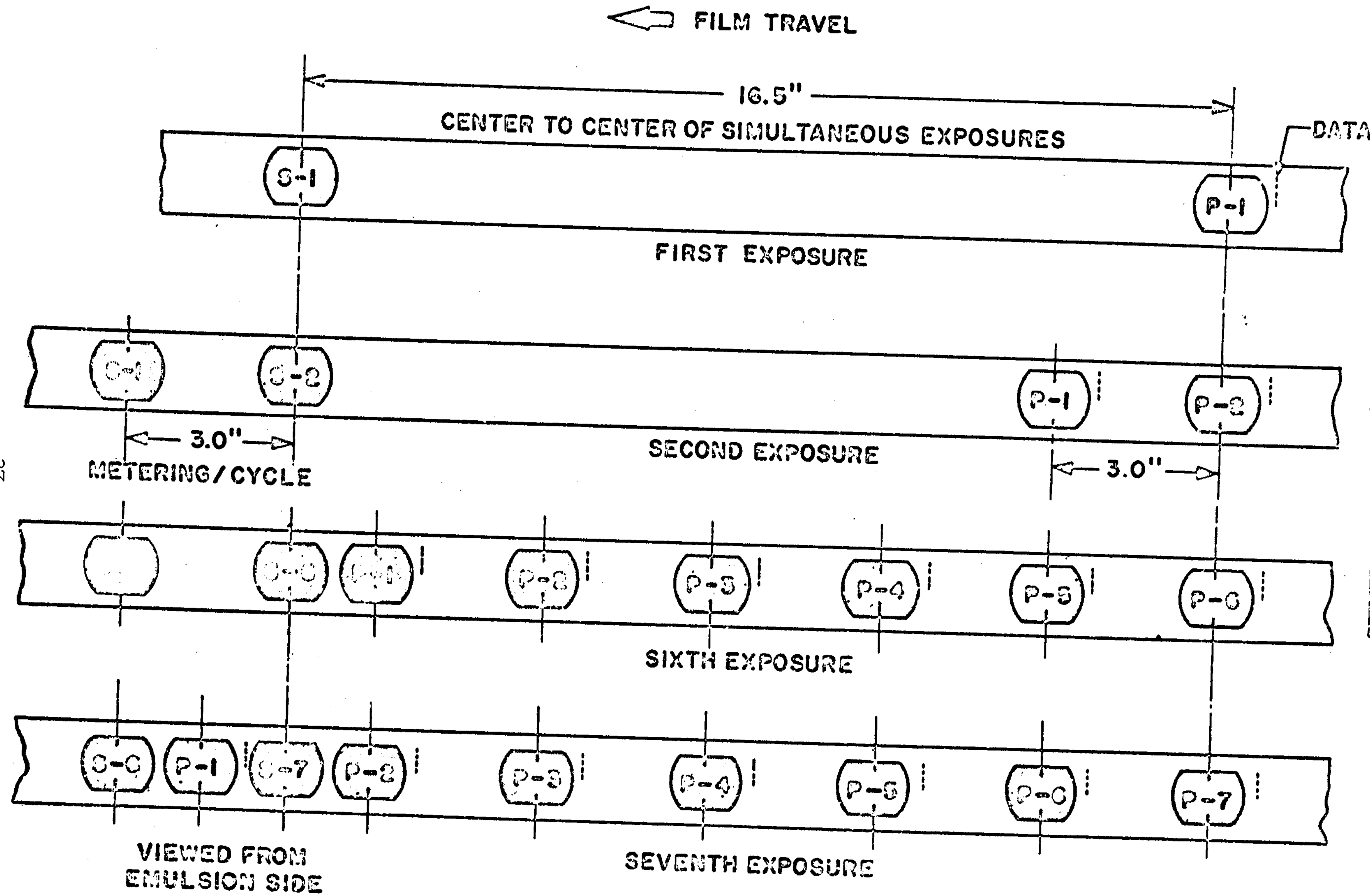
DISIC TIMING DIAGRAM

Figure 4-4



DISIC FUNCTIONAL SCHEMATIC

Figure 4-5



STELLAR CAMERA EXPOSURE SEQUENCE

Figure 4-6

Camera Formats

A sketch of the stellar camera format is shown in Figure 4-7. The lens serial number is exposed by each stellar camera while the time word is exposed only by the port stellar camera. The port stellar image is further identified by a "P" after the lens serial number. The detail of the time word display and start-of-pass mark are shown in Figure 4-8.

The format sketch of the terrain camera is shown in Figure 4-9 and the detail of the time word in Figure 4-10.

Camera Calibration

The DISIC reseau intersections are calibrated prior to camera assembly. DISIC subsystem calibration data are obtained through stellar photographic (Patio) tests, and the Army Map Service (AMS) performs the reduction of these data. The calibration accuracies are listed in Table 4-2.

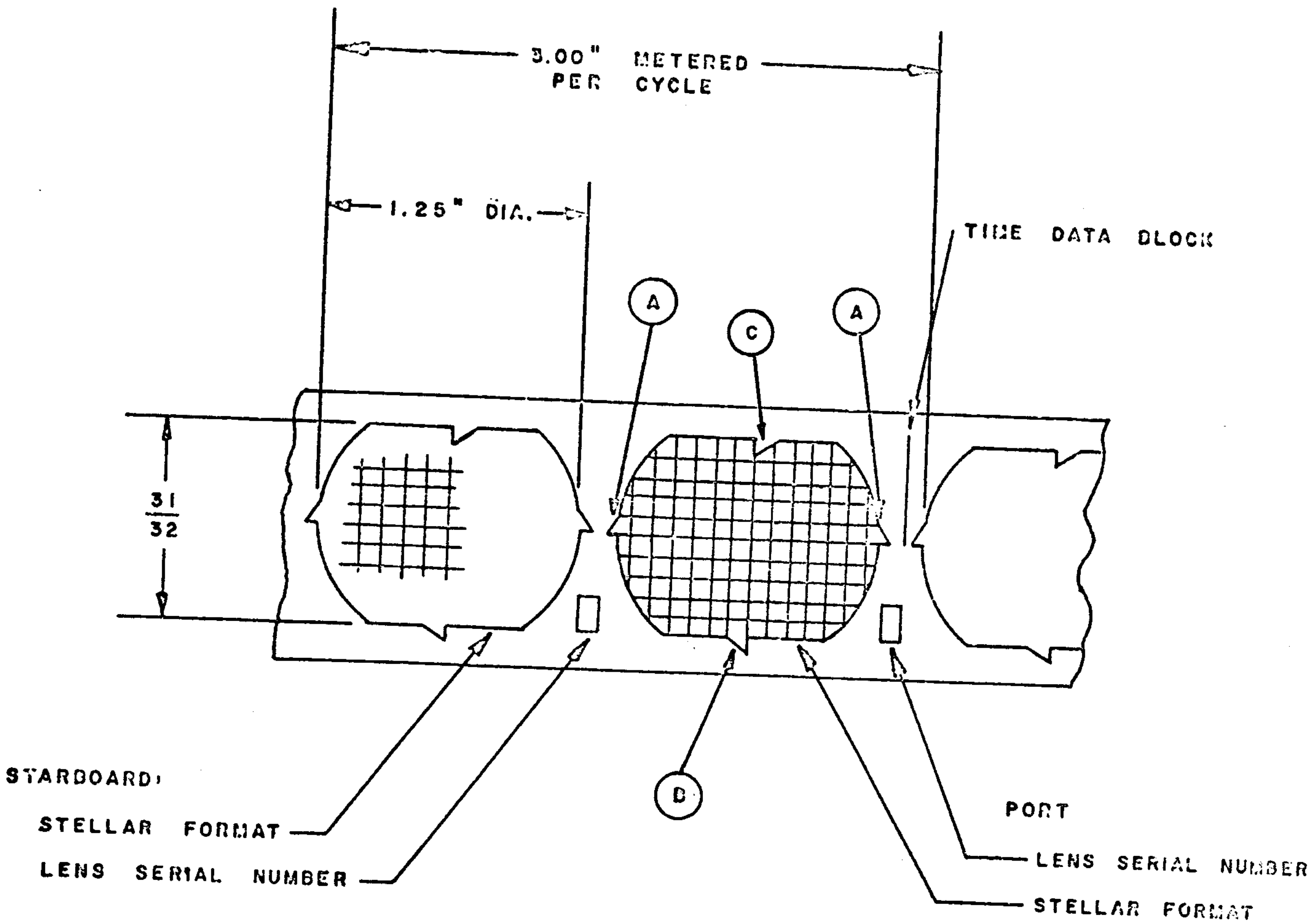
Terrain Camera Coverage

A listing of the coverage and overlap of the terrain camera is shown below for selected altitudes between 80 N.M. and 120 N.M.

Altitude - N.M.		80	90	100	110	120
Side Dimension of Ground Pattern - N.M.		120.16	135.6	150.7	165.8	180.8
Area Coverage per Frame - Sq. N.M. x 10^4		1.45	1.84	2.27	2.75	3.27
Overlap - %	9.375 Sec/Cycle	68.0	71.6	74.4	76.7	78.7
	12.50 Sec/Cycle	57.4	62.1	65.9	69.0	71.6

Telemetry

The sequence of camera functions that are instrumented for telemetry are illustrated in Figure 4-11.



FIDUCIAL INDICATIONS:

(A) FLIGHT DIRECTIONS

(B) FILM METERING

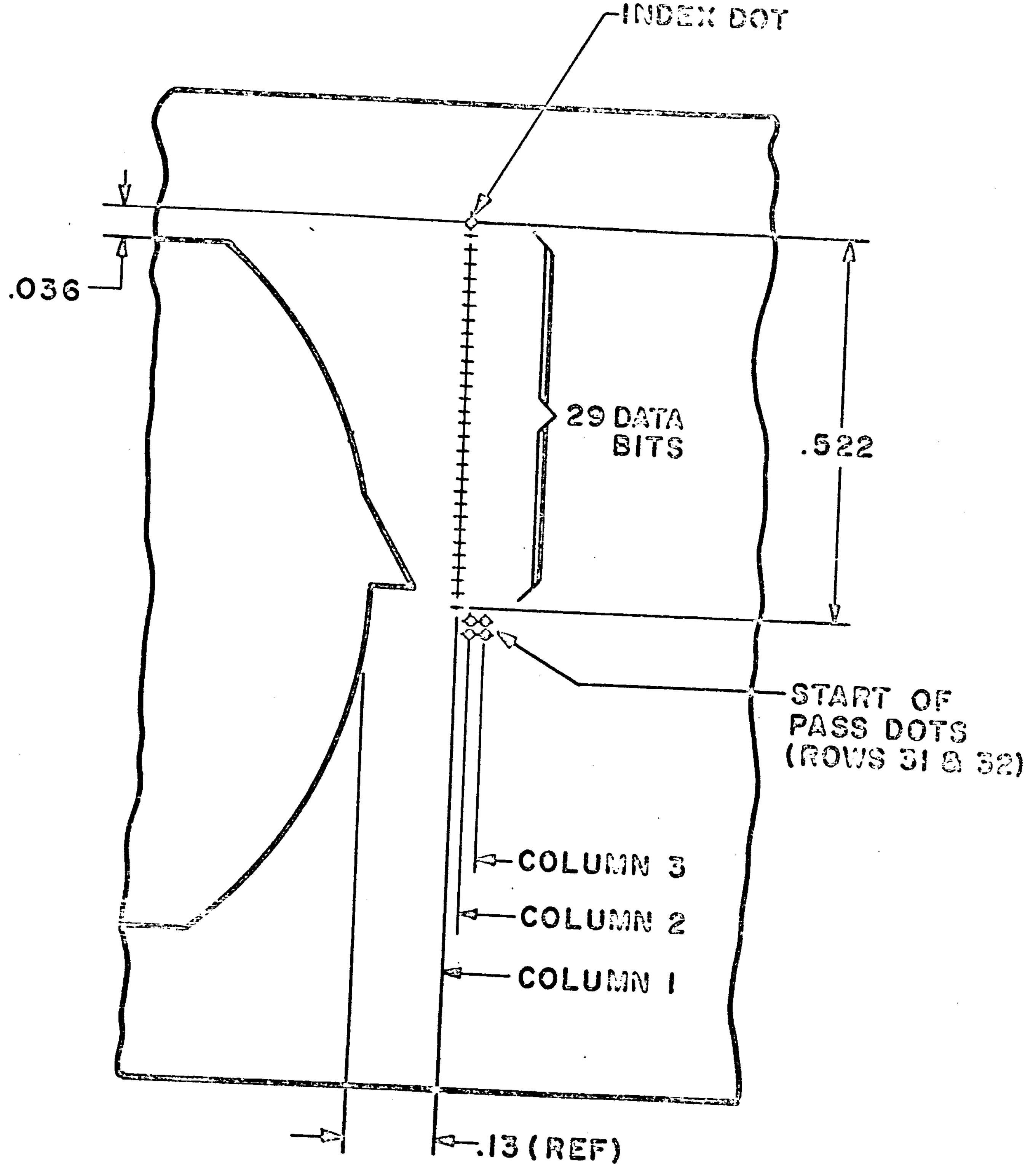
(C) FRAME TIME WORD

ORIGINAL NEGATIVE VIEWED EMULSION UP.

RESEAU GRID SPACING 2.5 MM

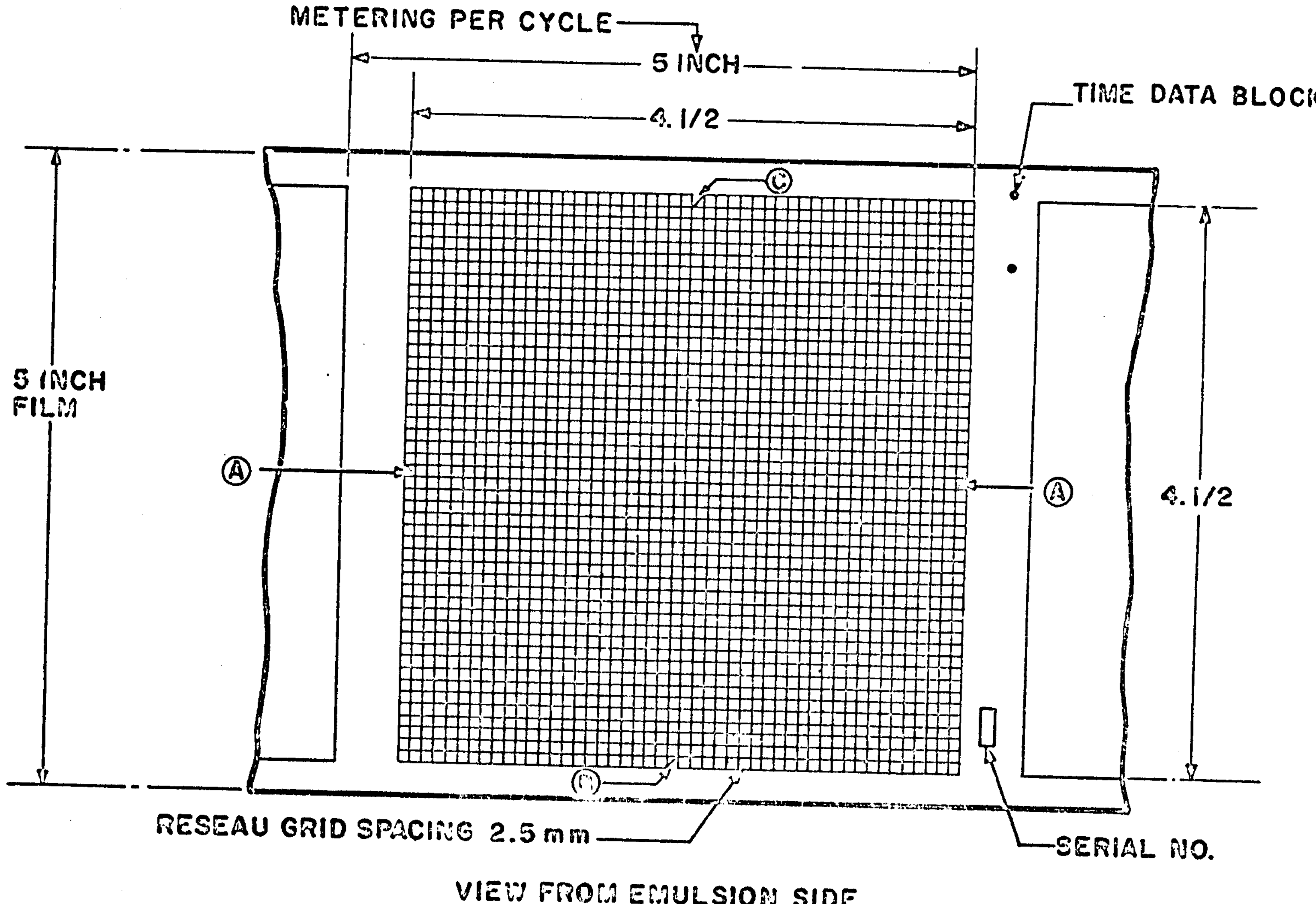
STELLAR CAMERA FORMAT

Figure 4-7



STELLAR CAMERA SLP FORMAT

Figure 4-8

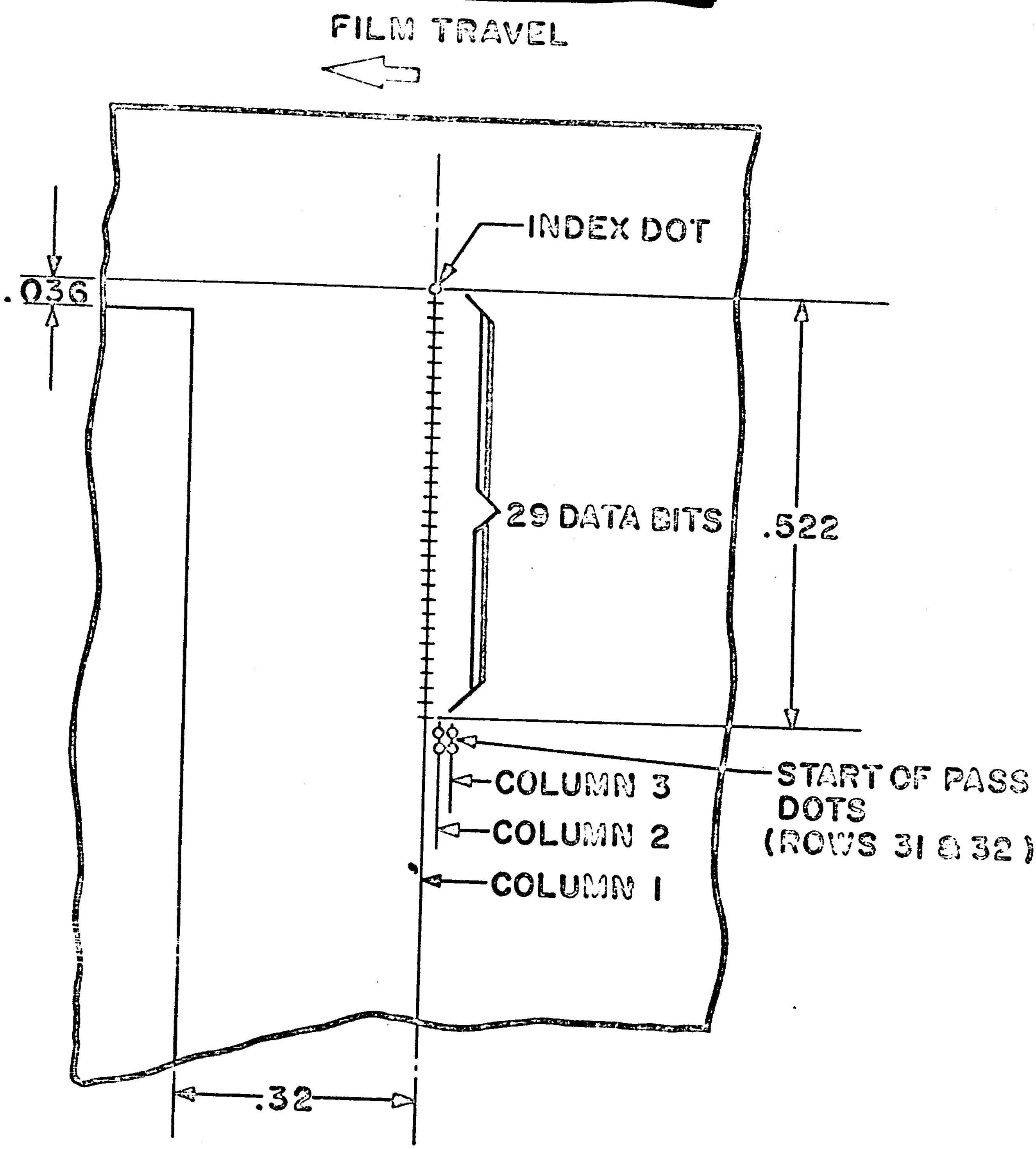


FIDUCIAL INDICATIONS

Ⓐ FLIGHT DIRECTION
Ⓑ FILM METERING
Ⓒ FRAME TIME WORD

TERRAIN CAMERA FORMAT

Figure 4-9



TERRAIN CAMERA SLP FORMAT

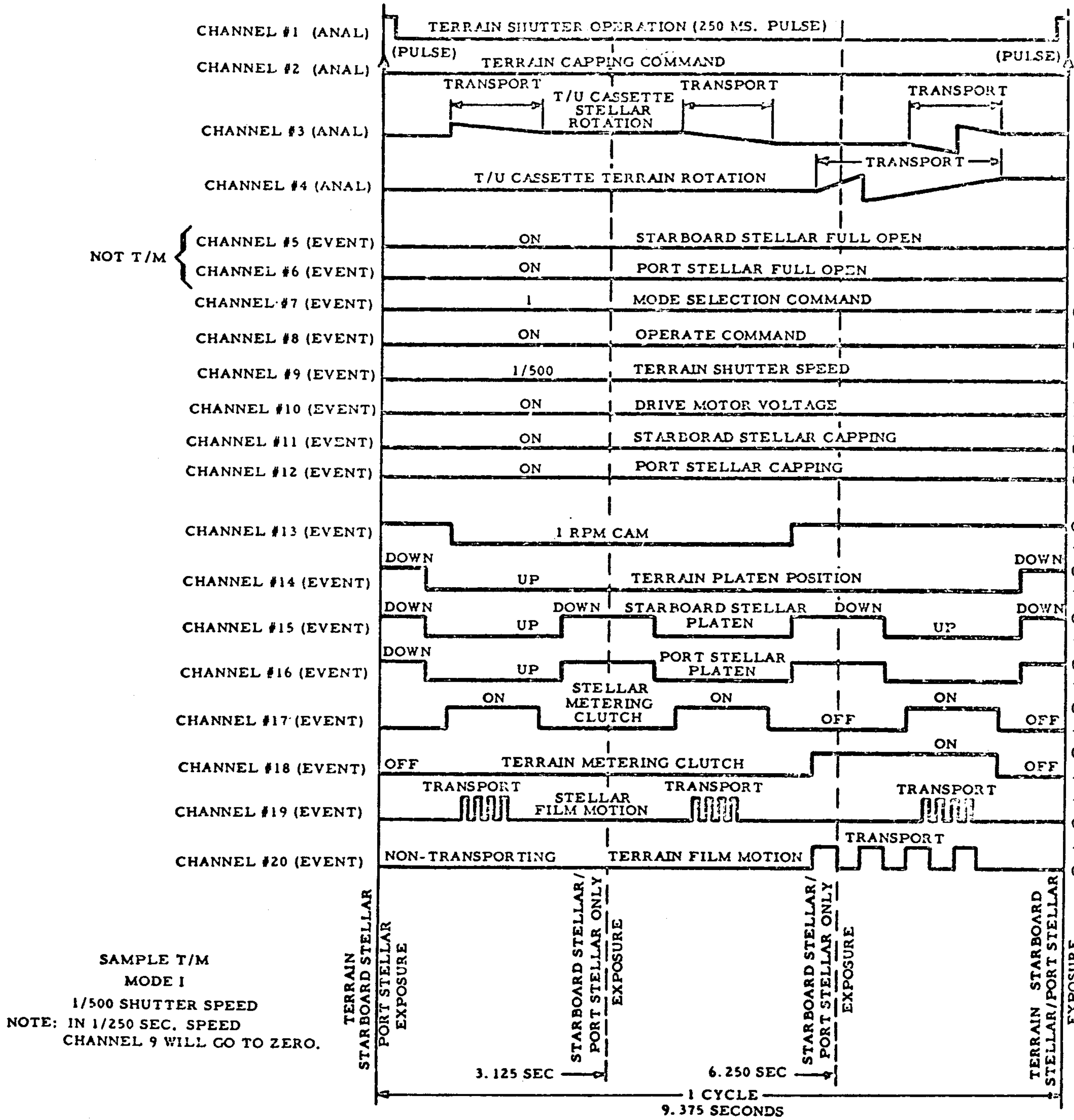
Figure 4-10

DISIC CALIBRATION

PARAMETER	TERRAIN	STELLAR
Distortion:		
Radial	3 Microns	3 Microns
Tangetial	3 Microns	3 Microns
Reseau Intersections	1 Micron	1 Micron
Principle Axis to Reseau Intersection	3 Microns	3 Microns
Knee Angles:		
Tilt	5 Arc Seconds	5 Arc Seconds
Swing	20 Arc Seconds	20 Arc Seconds
Azimuth	30 Arc Seconds	30 Arc Seconds
Equivalent Focal Length	10 Microns	10 Microns
Calibrated Focal Length Computed to	1 Micron	1 Micron

(All values above are $\pm$ and are 1 sigma.)

Table 4-2



DISIC TELEMETERY TIMING DIAGRAM

Figure 4-11