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SKYLAB EXPERIMENT PERFORMANCE EVALUATION MANUAL

Appendix Q: Experiment T013 Crew/Vehicle Disturbances (MSFC/LaRC)

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Prepared for

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16. ABSTRACT

This appendix contains a series of analyses for Experiment T013, Crew/Vehicle Disturbances (MSFC/LaRC), to be used for evaluating the performance of the Skylab corollary experiments under preflight, inflight, and post-flight conditions. Experiment contingency plan workaround procedure and malfunction analyses are presented in order to assist in making the experiment operationally successful.

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DEFINITION OF SYMBOLS

Symbol	Definition
A	Arm
ALL	Commander/Pilot/Scientist Pilot
AM	Airlock Module
ANG	Angle
APCS	Attitude Pointing and Control System
A. S. S.	Acquisition Sun Sensor
ATM	Apollo Telescope Mount
CAL	Calibrate
cb	Circuit breaker
CDR	Commander
CMG	Control Moment Gyro
DAC	Data Acquisition Camera
EDS	Experiment Data System
EPC	Experiment Pointing Control
EXP	Experiment
FBD	Functional Block Diagram
FD	Forward
FMS	Force Measuring System
FMU	Force Measuring Unit

DEFINITION OF SYMBOLS (Continued)

Symbol	Definition
FO	Functional Objective
HP	Hip
IDENT	Identification
kbits/sec	Kilo bits per second
L	Left
LC	Load Cell
LCB	Load Cell Bridge
LIMS	Limb Motion Sensor Assembly
MSFN	Manned Space Flight Network
NRZ-L	Nonreturn to zero level
OA	Orbital Assembly
OBS	Observer
OWS	Orbital Workshop
PCM	Pulse Code Modulation
PLT	Pilot
P_{f_t}	Total probability of failure
P_s	Probability of success
R	Right
RE	Rear

DEFINITION OF SYMBOLS (Concluded)

Symbol	Definition
RZ	Return to zero
SAL	Scientific Airlock
SC	Scale
SD	Shoulder
SL	Skylab
SUB	Subject
UPR	Upper

SECTION I.

EXPERIMENT T-013, CREW/VEHICLE DISTURBANCES PRE-FLIGHT OPERATION EVALUATION ANALYSIS

TABLE Q-I. EXPERIMENT T-013, CREW/VEHICLE DISTURBANCES PRE-FLIGHT OPERATION EVALUATION ANALYSIS (Sheet 1 of 11)

FUNCTIONAL BLOCK NUMBER AND TITLE	EXPECTED RANGE AND DIMENSION OF VARIABLES			CRITICALITY CATEGORY NUMBER*	REMARKS
	MIN.	NOM.	MAX.		
3.0 Analyze and predict facet performance profile for Skylab Experiment T-013, Crew/Vehicle Disturbances.				N/A	Refer to functional item 3.1.
3.1 Make explicit statements about objectives in qualitative and quantitative terms.				N/A	Refer to functional item 3.1.1.
3.1.1 Specify duration that the experiment is required to operate and provide useful information.				N/A	The experiment is performed in the Orbital Workshop (OWS) by one crewman while another crewman serves as the observer. The third crewman will participate during one phase of the experiment. The body motions of the subject are measured by an instrumented suit and correlated photography. In addition, the applied forces and moments produced by the subject while performing the experiment tasks are measured by T-013 equipment. The experiment is divided into the following tasks and corresponding times:

Tasks	Time (min)
• Experiment Preparation	34
• Restrained Operation on Force Measuring Unit (FMU) No. 1 (performed twice)	16
• Free Soaring Between FMU's (performed twice)	8
• Simulated Apollo Telescope Mount (ATM) Console Tasks in OWS	5
• Post Operation	17
Total	80

* Criticality Category Number Definition:

- Category I--Experiment and equipment whose failure could adversely affect crew safety.
- Category II--Experiment and equipment whose failure could result in not achieving a primary mission objective, but does not adversely affect crew safety.
- Category IIIa--Experiment and equipment whose failure could result in not achieving a secondary mission objective, but which does not adversely affect crew safety or preclude the achievement of any primary mission objective.
- Category IIIb--Experiment and equipment whose failure could not result in a loss of primary or secondary mission objectives and does not adversely affect crew safety.

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TABLE Q-I. EXPERIMENT T-013, CREW/VEHICLE DISTURBANCES PRE-FLIGHT OPERATION EVALUATION ANALYSIS (Sheet 2 of 11)

FUNCTIONAL BLOCK NUMBER AND TITLE	EXPECTED RANGE AND DIMENSION OF VARIABLES			CRITICALITY-CATEGORY NUMBER*	REMARKS
	MIN.	NOM.	MAX.		
3 1.1 (Concluded)					Simulated ATM tasks must be performed over a ground tracking station in order to obtain real-time coverage of ATM/Attitude Pointing and Control System (APCS) data. References 1 and 2
3. 1 2 Specify the types of criteria that are to be maximized or minimized.				N/A	The objectives of Experiment T-013 are· • Evaluate spacecraft disturbances caused by typical inflight crew motions • Obtain ATM/APCS performance data in response to the crewman's motion • Verify ground-based simulation program data • Evaluate the Skylab ATM/APCS design and assess its accuracy References 1 and 2.
3. 1. 3 Specify the percentage of acceptable max. /min. for each objective.				N/A	It is expected that a minimum performance value of approximately 16 to 24 percent for each Functional Objective (FO) will be acceptable. This represents an accomplishment of 80 percent for each FO, 80 percent for the entire T-013 experiment is acceptable The objectives of Experiment T-013 are
	24%	26%	30%		• Evaluate spacecraft disturbances caused by typical inflight crew motions
	20%	22 5%	25%		• Obtain ATM/APCS performance data in response to the crewmen's motions
	16%	18%	20%		• Verify ground-based simulation program data
	20%	22 5%	25%		• Evaluate the Skylab ATM/PCS design and assess its accuracy
	80%	90%	100%		Total percentage of acceptable max. /min. References 1, 2, and 3.
3 1. 4 Specify experiment constraints • Musts • Must Nots • Wants • Don't Wants				N/A	• Musts --All equipment that may interfere with experiment performance must be cleared from the surrounding area during experiment performance --All physical activity of the crew except as delineated in the experiment procedures, including housekeeping functions, must be constrained for approximately 30 min during experiment data collecting. --During the experiment performance, the APCS must be in active status with the Orbital Assembly (OA) in the solar inertial mode and the automatic Control Moment Gyro (CMG) desaturation maneuvers inhibited

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TABLE Q-I. EXPERIMENT T-013, CREW/VEHICLE DISTURBANCES PRE-FLIGHT OPERATION EVALUATION ANALYSIS (Sheet 3 of 11)

FUNCTIONAL BLOCK NUMBER AND TITLE	EXPECTED RANGE AND DIMENSION OF VARIABLES			CRITICALITY CATEGORY NUMBER*	REMARKS
	MIN.	NOM.	MAX.		
3 1.4 (Concluded)					--For data recording, during simulated ATM console tasks in the OWS, the OA must be in contact with a ground station to obtain real-time data • Must Nots --The Antisolar Scientific Airlock (SAL) must not be in use during experiment operations • Wants --During T-013 real-time data transmissions, interruptions between ground tracking stations should be held to a minimum • *Don't Wants* --N/A References 1 and 2
3 1.5 Specify experiment operational tolerances • Must • Must Nots • Wants • Don't Wants				N/A	Refer to functional item 3 1 4
3 2 Define the decision rules and success criteria for the experiment objectives				N/A	If the experiment is aborted, then the probability of success (P_s) is equal to 0 0 If the experiment is compromised and minimum information is salvaged, P_s = 0 1 – 0 5 if maximum information is salvaged, P_s = 0 5 – 0 9 If the experiment is completed as scheduled P_s = 1 0 The success criteria are • An astronaut shall perform various body movements, stationary motions, and translations for 30 min using the Limb Motion Sensor Assembly (LMS) and Force Measurement System (FMS) in the OWS A minimum of 5 min real-time APCS telemetry data shall be obtained (30 min of real-time data is desired) Related film and voice data shall be obtained References 1, 2, and 4

TABLE Q-1. EXPERIMENT T-013, CREW/VEHICLE DISTURBANCES PRE-FLIGHT OPERATION EVALUATION ANALYSIS (Sheet 4 of 11)

FUNCTIONAL BLOCK NUMBER AND TITLE	EXPECTED RANGE AND DIMENSION OF VARIABLES			CRITICALITY CATEGORY NUMBER*	REMARKS
	MIN.	NOM.	MAX.		
3.3 Specify experiment priority (numerical statement) for a given Skylab flight designation.				N/A	Experiment T-013 has a priority number of 270. Because of inconsistencies in documentation, the specific mission assignment for T-013 is not available; however, it is expected to be performed on SL-4. References 1, 2, 3, 4, and 5.
3.4 Briefly describe and list the major subsystems for Experiment T-013.				N/A	Refer to functional items 3.4.1 and 3.4.2.
3.4.1 Describe the major functions.				N/A	Experiment T-013 is designed to evaluate spacecraft disturbances caused by typical inflight crew motions. The astronaut performing the experiment will complete a predetermined schedule of movements and activities that will be measured, coordinated, and compared with the OWS and ATM/APCS data. The motions of the astronaut will be measured by the LIMS and the FMS. The LIMS is an exoskeletal structure that is integrated into a suit to measure the subject's arm and leg motions. The measurements are detected by transducers located at major joints of the body. The FMS consists of a pair of instrumented platforms that measure the applied forces and moments produced by a crewman performing the tasks. References 1 and 2.
3.4.2 List the major components.				N/A	The major subsystem components of Experiment T-013 are: • Force Measuring System • Limb Motion Sensor Assembly • LIMS data Cable • Experiment Data System (EDS) • LIMS Stowage Container. Reference 1.
3.5 Define the T-013 experiment/carrier subsystem interface:				N/A	A Functional Block Diagram (FBD) is submitted as Figure R-1, and provides a subsystem component listing. Critical subsystem components will be identified, evaluated for failure, and correlated to possible experiment/carrier interface problems.

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TABLE Q-I. EXPERIMENT T-013, CREW/VEHICLE DISTURBANCES PRE-FLIGHT OPERATION EVALUATION ANALYSIS (Sheet 5 of 11)

FUNCTIONAL BLOCK NUMBER AND TITLE	EXPECTED RANGE AND DIMENSION OF VARIABLES			CRITICALITY CATEGORY NUMBER*	REMARKS
	MIN.	NOM.	MAX.		
3.5 (Concluded) • Physical --Mechanical --Electrical --Communications and Data --Support. • Environmental --Natural and Induced --Contamination. • Operational --Pointing and Control --Crew Safety --Sequence --Operability.					
3.5.1 Force Measuring System.				N/A	Refer to functional item 3.5.1.1.4.1.
3.5.1.1.4.1 Specify the total probability of failure (P_{f_t}) for a load cell.		nil		II	There are six load cells in each of the two FMU's. The load cells will be used to measure the forces applied to the sensing plate of each FMU. The load cells generate electrical output proportional to stress and compression forces along the axis of the load cell. The load cells are BYTREX Model JP-100. If a load cell should fail, the following situation could occur: • Data --No output or inaccurate data from faulty load cell. The following indication can be used to determine the failure of a load cell: • Ground detection of partial loss of FMS data during real time calibration of FMS. Load cell data located in frames 2, 4, 6, 8, 10, and 12 of each submaster frame of the Pulse Code Modulation (PCM) data. NOTE: No crew detection of internal failure is possible for the functional blocks examined. References 1, 2, 6, and 11.

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TABLE Q-I. EXPERIMENT T-013, CREW/VEHICLE DISTURBANCES PRE-FLIGHT OPERATION EVALUATION ANALYSIS (Sheet 6 of 11)

FUNCTIONAL BLOCK NUMBER AND TITLE	EXPECTED RANGE AND DIMENSION OF VARIABLES			CRITICALITY CATEGORY NUMBER*	REMARKS
	MIN.	NOM.	MAX.		
3.5.1.1.7 Specify the (P_{f_t}) for the signal conditioner.		nil		II	Each FMU signal conditioner receives differential inputs from the six load cells, amplifies and conditions the inputs, and sends the outputs to the EDS. The signal conditioners receive 28 Vdc from OWS Bus No. 2, panel No. 613. The signal conditioner provides +4.8 Vdc excitation voltage for the six load cells and ± 15 Vdc biasing voltage for the instrumentation amplifiers of the signal conditioner. If the signal conditioner should fail, the following situation would occur: • Data --No load cell data output due to internal failure --Erroneous load cell data output. The following indication can be used to determine the failure of the signal conditioner: • Refer to 3.5.1.1.4.1. References 1, 2, 6, 8, and 11.
3.5.2 Limb Motion Sensor Assembly.				N/A	Refer to functional item 3.5.2.1.
3.5.2.1 Specify the P_{f_t} for the potentiometers.		nil		II	Sixteen linear potentiometers are located at each of the 16 joints of the exoskeletal structure. Twelve of the potentiometers are SPECTROL Model 140 which measure angular rotation. Four of the potentiometers are Model 164 which measure axial rotation. The potentiometers convert the mechanical motion of the exoskeletal structure into an electrical signal that is fed into the EDS through the LIMS data cable. The excitation voltage (+4.7 Vdc) for the potentiometers is provided by the dc-dc converter of the EDS. If a potentiometer should fail, the following situation could occur: • Data --No output due to open or shorted potentiometer. The following indication can be used to determine the failure of a potentiometer: • Ground detection of loss of potentiometer output from AM tape dumps. LIMS output data located in words 1, 2, and 3 of frames 3, 5, and 7 and word 3 of frames 2, 4, 6, 8, 10, 11, and 12 of each submaster frame of EDS PCM output. References 1, 2, 6, 10, and 11.
3.5.4 Experiment Data System.				N/A	Refer to functional item 3.5.4.1.

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TABLE Q-I. EXPERIMENT T-013, CREW/VEHICLE DISTURBANCES PRE-FLIGHT OPERATION EVALUATION ANALYSIS (Sheet 7 of 11)

FUNCTIONAL BLOCK NUMBER AND TITLE	EXPECTED RANGE AND DIMENSION OF VARIABLES			CRITICALITY CATEGORY NUMBER	REMARKS
	MIN.	NOM.	MAX.		
3.5.4.1 Specify the Pf_t for the dc-dc converter.		nil		II	The dc-dc converter supplies the voltage and currents required by the LIMS power supply and the PCM encoder. Input to the converter is +28 Vdc from OWS Bus No. 2, panel No. 613, with nominal +5 Vdc, +15 Vdc, and -15 Vdc outputs. If the dc-dc converter should fail, the following situation could occur: • Data --No output or partial output due to faulty internal operation. The following indications can be used to determine the failure of the dc-dc converter: • No output or partial output of all EDS data from Airlock Module (AM) tape dumps. References 1, 2, 6, and 7.
3.5.4.2 Specify the Pf_t for the LIMS power supply.		nil		II	The LIMS power supply receives a +15 Vdc input from the dc-dc converter and produces a +4.7 ±0.05 Vdc excitation voltage to the limb motion sensing potentiometers. The LIMS power supply is located in the bilevel sampler. If the LIMS power supply should fail, the following situation could occur: • Data --No LIMS output or LIMS output is erroneous. The following indication can be used to determine the failure of the LIMS power supply: • Refer to functional item 3.5.2.1.
3.5.4.3 PCM Encoder				N/A	Refer to functional item 3.5.4.3.1.
3.5.4.3.1 Specify the Pf_t for the programmer.		nil		II	The programmer generates the timing signals that control the sequential operation of the encoder. The clock signal that controls the programmer is a crystal-controlled 5.76 kHz signal (5.76 kbits/sec). The clock signal is fed directly to an 8-stage bit counter and is gated to a 3-stage word counter and a 12-stage frame counter. These counters generate the signals necessary to produce the data format shown below:

TABLE Q-I. EXPERIMENT T-013, CREW/VEHICLE DISTURBANCES PRE-FLIGHT OPERATION EVALUATION ANALYSIS (Sheet 8 of 11)

FUNCTIONAL BLOCK NUMBER AND TITLE	EXPECTED RANGE AND DIMENSION OF VARIABLES			CRITICALITY CATEGORY NUMBER	REMARKS
	MIN.	NOM.	MAX.		
3.5.4.3.1 (Continued)					

T-013 Data Format

	WORD 1	WORD 2	WORD 3
1	SYNC	SYNC	SYNC
2	F1	F2	L1
3	L2	L3	L4
4	F3	F4	L5
5	L6	L7	L8
6	F5	F6	L9
7	L10	L11	L12
8	F7	F8	L13
9	SPARE	SPARE	SPARE
10	F9	F10	L14
11	LIMS CAL (C3)	FMU 1 CAL (C1)	L15
12	F11	F12	L16
1	TIME	TIME	TIME
2	F1	F2	L1
3	L2	L3	L4
4	F3	F4	L5
5	L6	L7	L8
6	F5	F6	L9
7	L10	L11	L12
8	F7	F8	L13
9	SPARE	SPARE	SPARE
10	F9	F10	L14
11	FMU 1 CAL (C1)	SPARE	L15
12	F11	F12	L16

8 Bits/Word, 72 Words at 10 samples/sec

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TABLE Q-I. EXPERIMENT T-013, CREW/VEHICLE DISTURBANCES PRE-FLIGHT OPERATION EVALUATION ANALYSIS (Sheet 9 of 11)

FUNCTIONAL BLOCK NUMBER AND TITLE	EXPECTED RANGE AND DIMENSION OF VARIABLES			CRITICALITY CATEGORY NUMBER	REMARKS
	MIN.	NOM.	MAX.		
3.5.4.3.1 (Concluded)					If the programmer should fail, the following situation could occur: • Data --Refer to functional item 3.5.4.1. The following indication can be used to determine the failure of the programmer: • Refer to functional item 3.5.4.1. References 1, 2, 6, 7, and 9.
3.5.4.3.2 Specify the Pf_t for the analog sampler.		nil		II	The analog sampler that is controlled by the programmer, gates through the 31 analog channels sequentially to the A/D converter. The sampler samples the 16 LIMS data channels, the 12 FMU data channels, and the 3 calibration channels, at a rate of 20 samples/sec. *If the analog sampler should fail, the following situation could occur:* • Data --No analog output or analog output is erroneous due to faulty internal operation. The following indication can be used to determine the failure of the analog sampler: • Ground detection of partial to total loss of analog data. References 1, 2, 6, 7, and 9.
3.5.4.3.4 Specify the Pf_t for the bilevel sampler.		nil		II	The bilevel sampler samples bilevel OWS clock signals and feeds data to the output data formatter. *The first frame of the second submaster of each master frame from the EDS* contains the 3 word AM time. This time synchronization of the EDS data is used to correlate astronaut motions with ATM/APCS data. The AM time is sampled at 10 samples/sec. If the bilevel sampler should fail, the following situation could occur: • Data --Loss of EDS and ATM/APCS time correlation. The following indications can be used to determine the failure of the bilevel sampler: • Ground detection of loss of erroneous time frame data. • Ground detection of no or erroneous EDS data. References 1, 2, 6, 7, and 9.

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TABLE Q-I. EXPERIMENT T-013, CREW/VEHICLE DISTURBANCES PRE-FLIGHT OPERATION EVALUATION ANALYSIS (Sheet 10 of 11)

FUNCTIONAL BLOCK NUMBER AND TITLE	EXPECTED RANGE AND DIMENSION OF VARIABLES			CRITICALITY CATEGORY NUMBER	REMARKS
	MIN.	NOM.	MAX.		
3.5.4.3.5 Specify the P_{f_t} for the sync word generator.		nil		II	The sync word generator consists of 3 encoders with outputs transmitted to the output data formatter. The sync word generator assures that the system will be self starting and have proper operating characteristics after a power interruption or turnoff. The sync word generator also provides the basic system clock frequency of 5.76 kHz. If the sync word generator should fail, the following situation could occur: • Refer to functional item 3.5.4.3.1. The following condition can be used to determine the failure of the sync word generator: • Refer to functional item 3.5.4.3.1. References 1, 2, 6, 7, and 9.
3.5.4.3.6 Specify the P_{f_t} for the output data formatter.		nil		II	The output data formatter converts the NRZ-L (nonreturn to zero level) data to transformer coupled RZ (return to zero) data and provides a transformer coupled data clock synchronized to the data. The data formatter multiplexes bilevel and analog data, sync and I.D. code words into a PCM pulse train. The data formatter also amplifies the EDS output to drive the input to the AM tape recorder. If the output data formatter should fail, the following situation could occur: • Refer to functional item 3.5.4.3.1. The following condition can be used to determine the failure of the output data driver: • Refer to functional item 3.5.4.3.1. References 1, 2, 6, 7, and 9.
3.5.6.3 Specify the P_{f_t} for the color interior film, SO-168.		0.50		III	Color interior film will be used to provide a photographic time history of the experiment and to provide sequence time correlation with the EDS and ATM/APCS data. If the film should fail, the following situation could occur: • Data --The film for this experiment is subject to degradation due to radiation fogging and low light levels. The pictures that will result from these anticipated conditions are expected to be of dubious quality, but may be acceptable for engineering purposes.

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TABLE Q-I. EXPERIMENT T-013, CREW/VEHICLE DISTURBANCES PRE-FLIGHT OPERATION EVALUATION ANALYSIS (Sheet 11 of 11)

FUNCTIONAL BLOCK NUMBER AND TITLE	EXPECTED RANGE AND DIMENSION OF VARIABLES			CRITICALITY CATEGORY NUMBER	REMARKS
	MIN.	NOM.	MAX.		
3.5.6.3 (Concluded)					The following indications can be used to determine the degradation of the film: • Higher than anticipated radiation levels in orbit • Examination of the film upon return. Reference 12.

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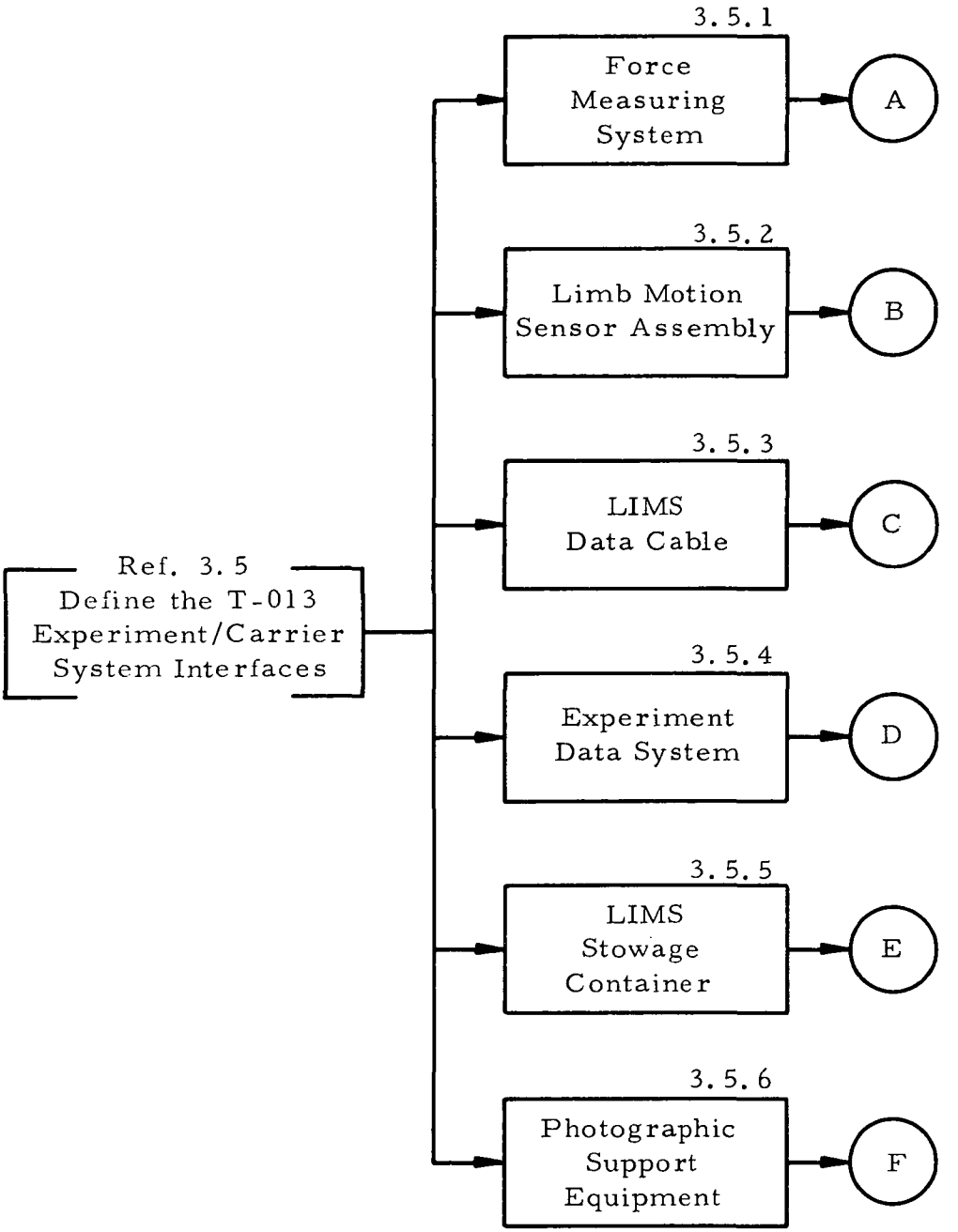


FIGURE Q-1. EXPERIMENT T-013, CREW/VEHICLE DISTURBANCES FUNCTIONAL BLOCK DIAGRAM (Sheet 1 of 15)

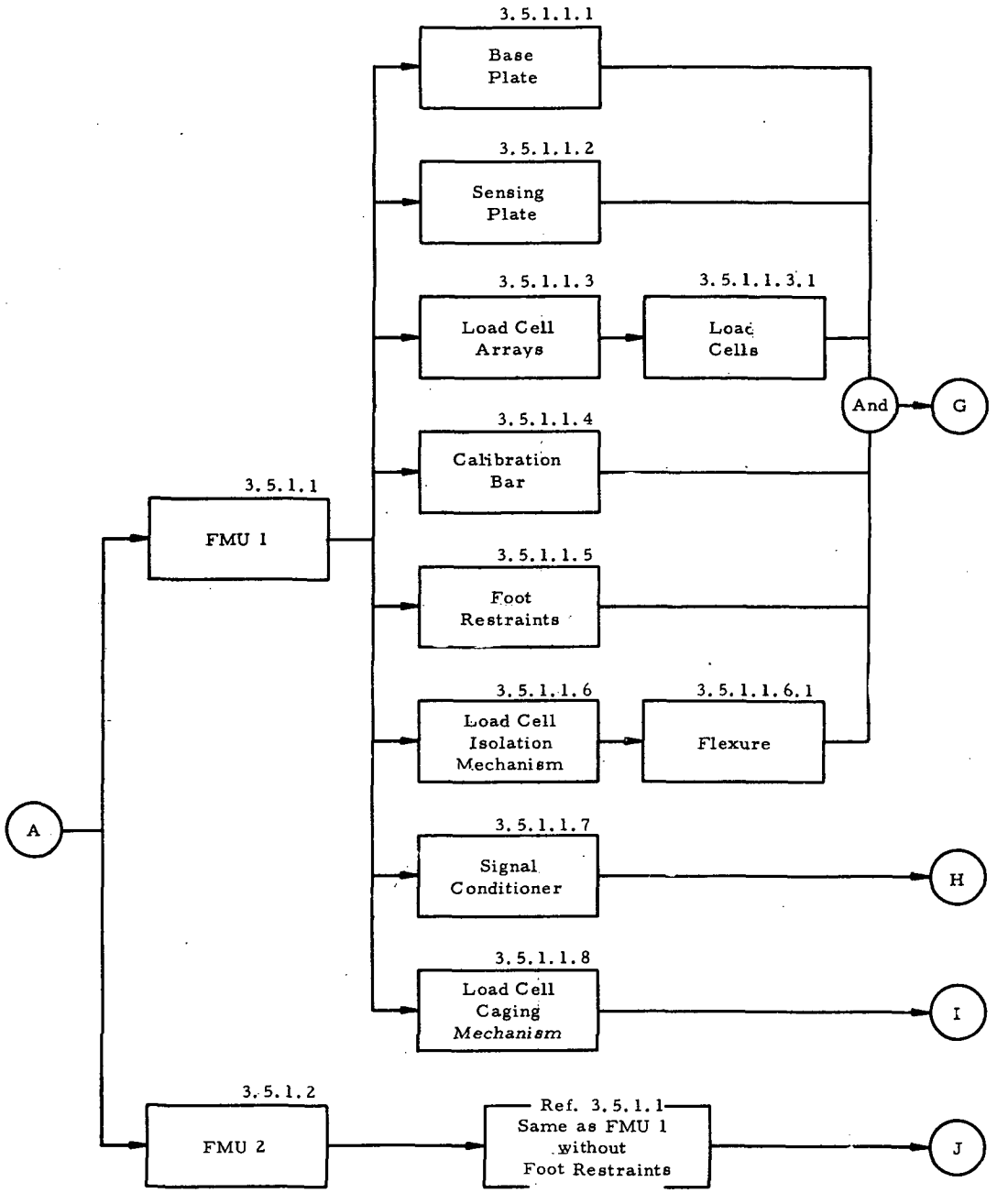


FIGURE Q-1. EXPERIMENT T-013, CREW/VEHICLE DISTURBANCES FUNCTIONAL BLOCK DIAGRAM (Sheet 2 of 15)

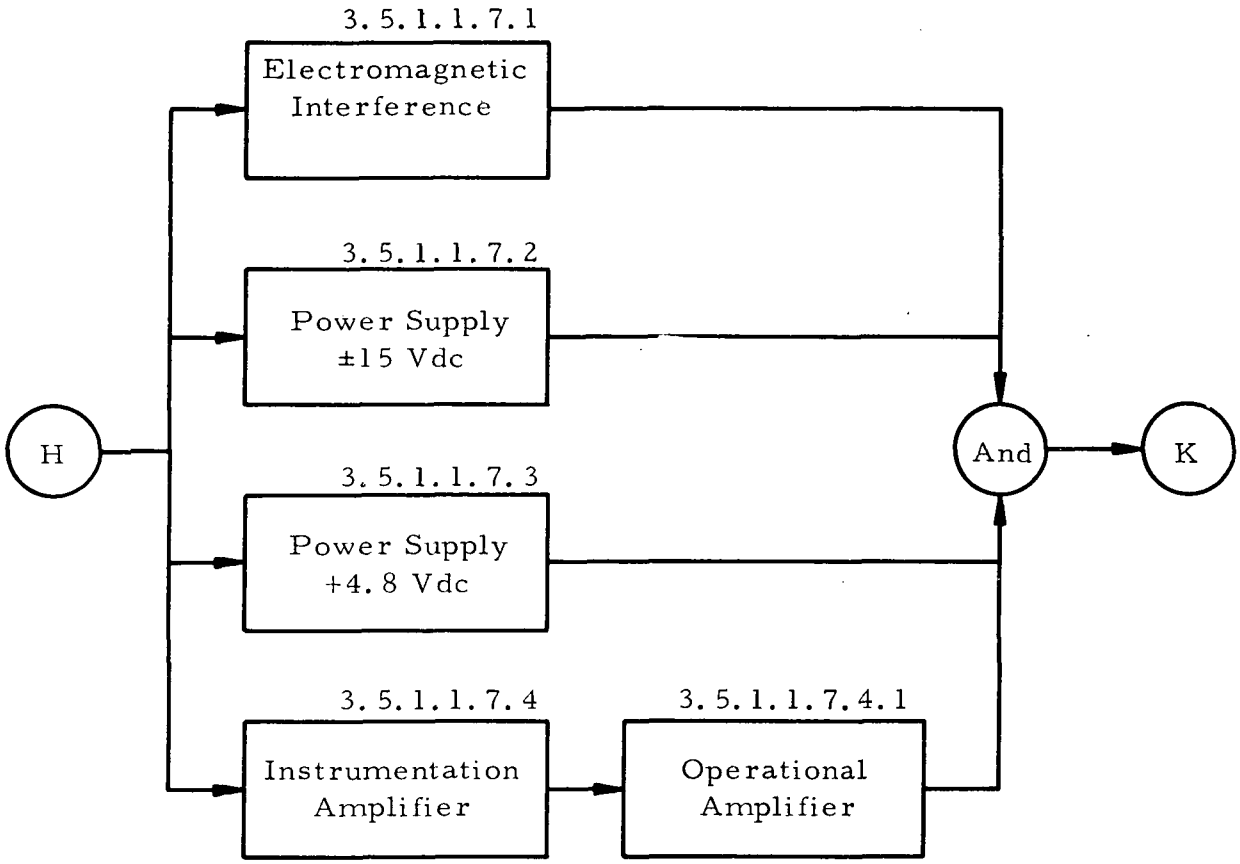


FIGURE Q-1. EXPERIMENT T-013, CREW/VEHICLE DISTURBANCES FUNCTIONAL BLOCK DIAGRAM (Sheet 3 of 15)

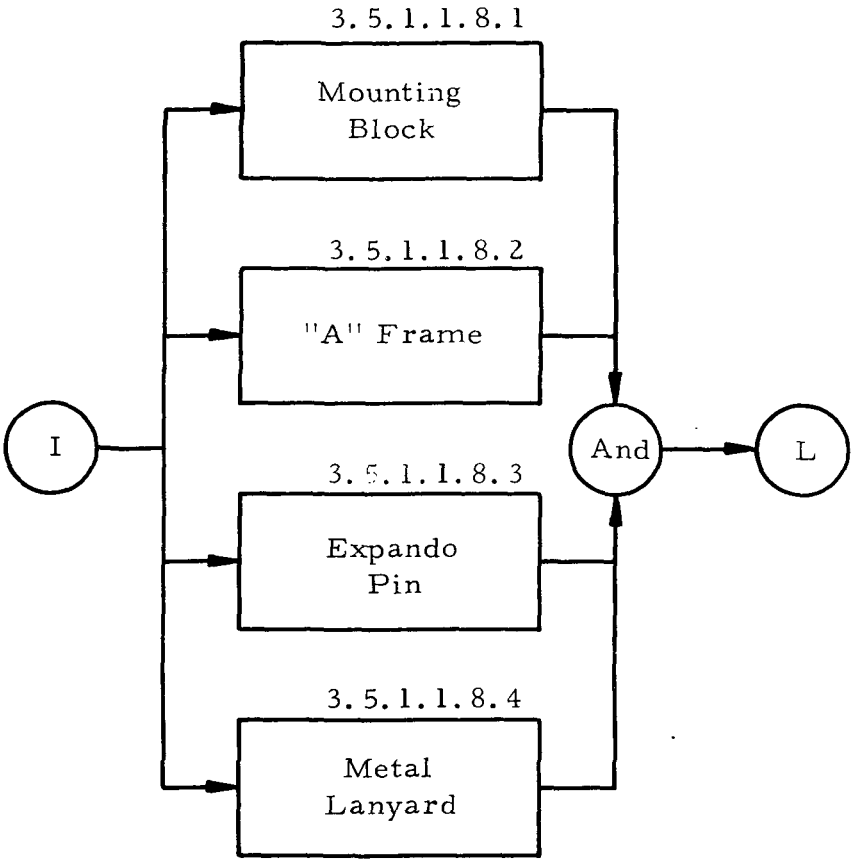


FIGURE Q-1. EXPERIMENT T-013, CREW/VEHICLE DISTURBANCES FUNCTIONAL BLOCK DIAGRAM (Sheet 4 of 15)

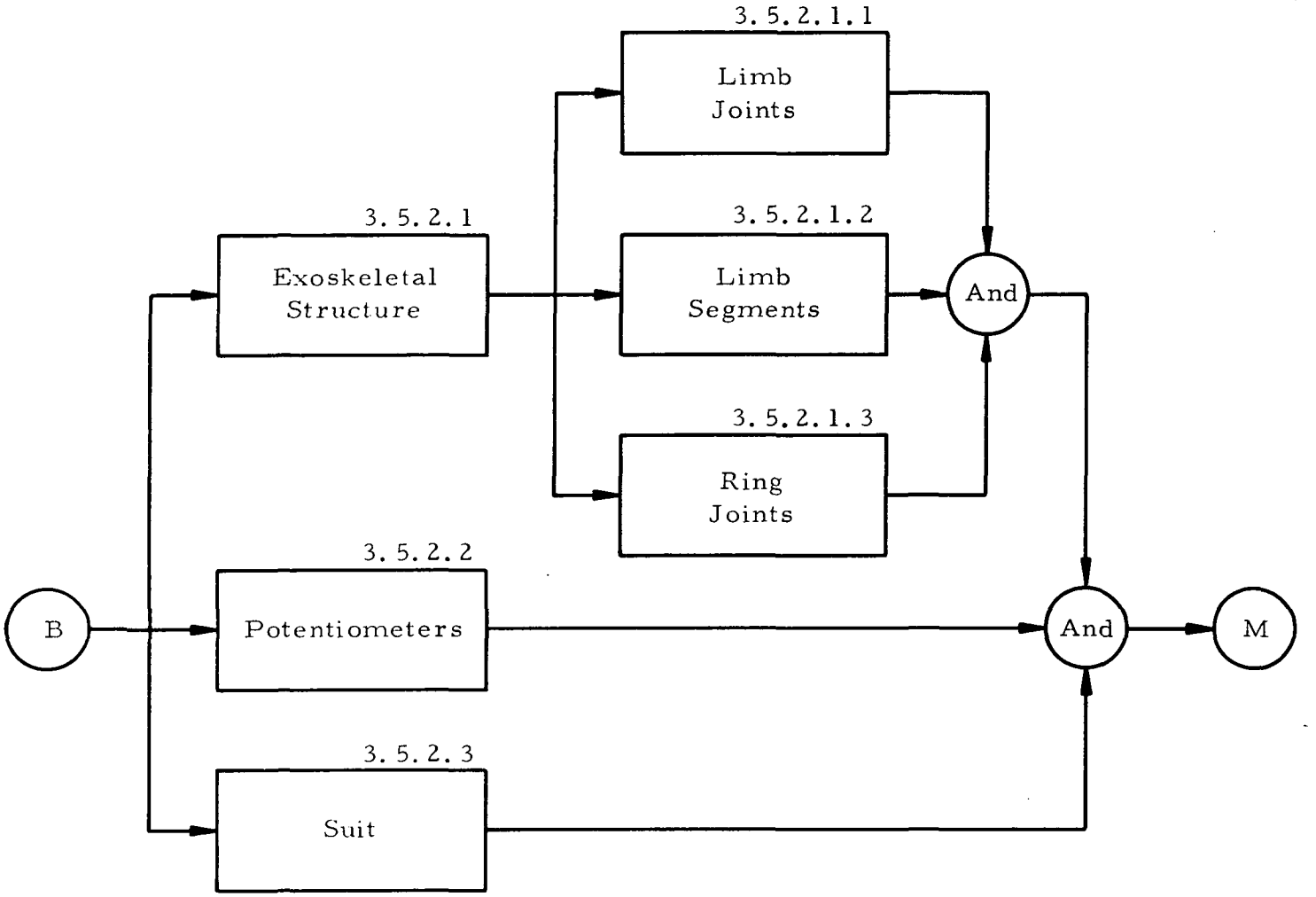


FIGURE Q-1. EXPERIMENT T-013, CREW/VEHICLE DISTURBANCES FUNCTIONAL BLOCK DIAGRAM (Sheet 5 of 15)

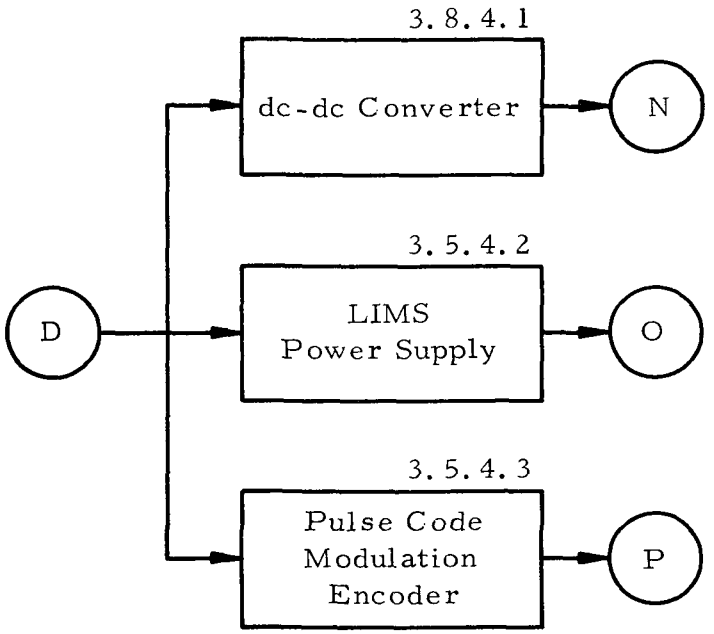


FIGURE Q-1. EXPERIMENT T-013, CREW/VEHICLE DISTURBANCES FUNCTIONAL BLOCK DIAGRAM (Sheet 6 of 15)

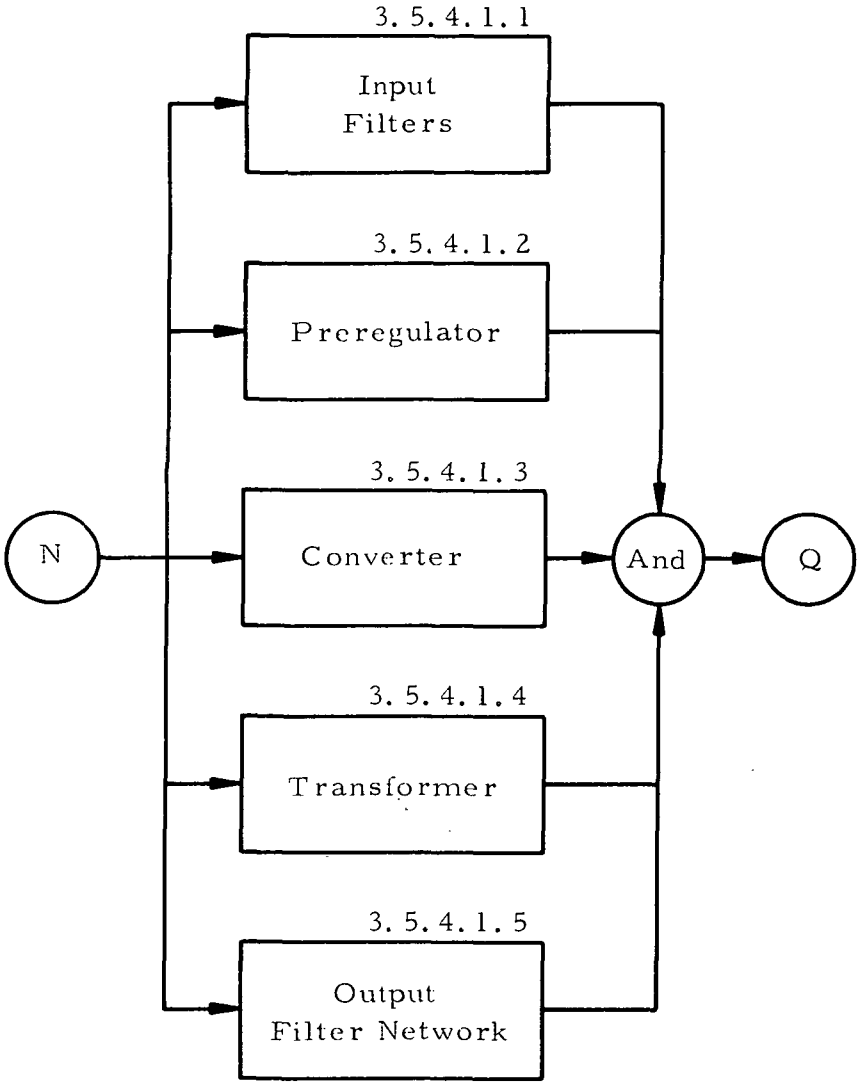


FIGURE Q-1. EXPERIMENT T-013, CREW/VEHICLE DISTURBANCES FUNCTIONAL BLOCK DIAGRAM (Sheet 7 of 15)

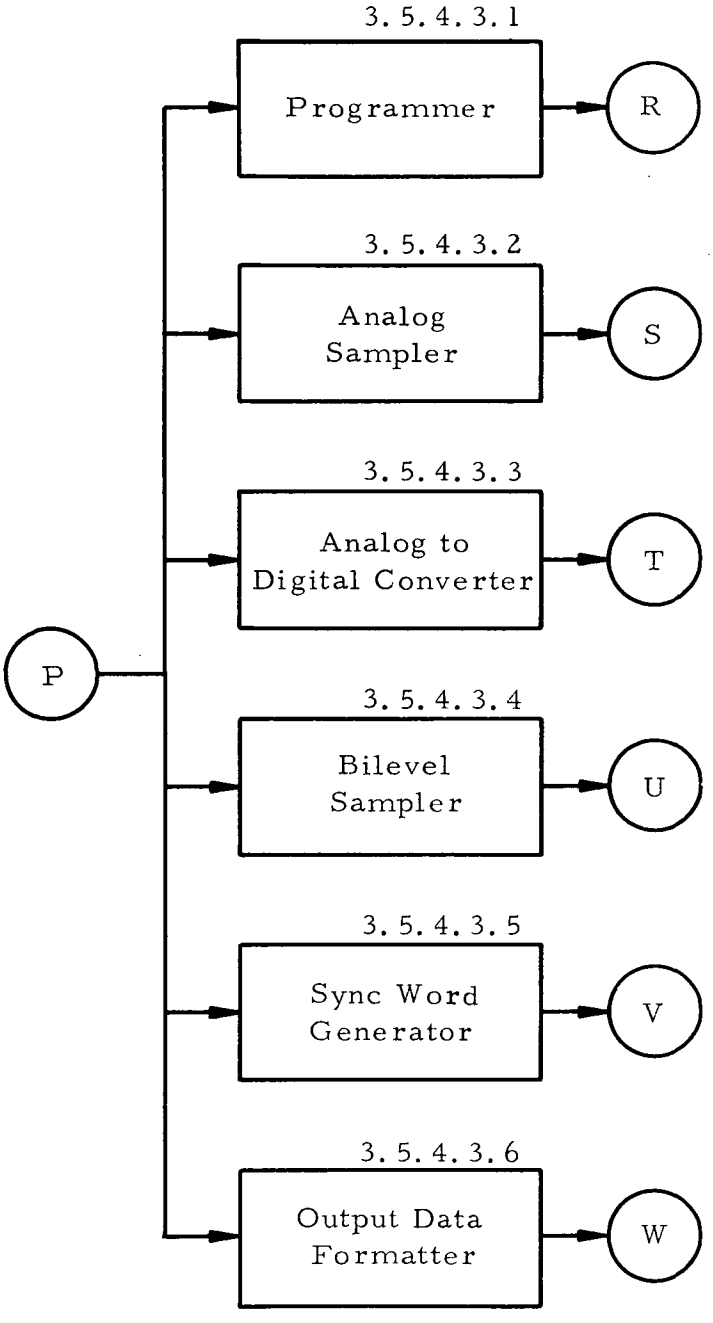


FIGURE Q-1. EXPERIMENT T-013, CREW/VEHICLE DISTURBANCES FUNCTIONAL BLOCK DIAGRAM (Sheet 8 of 15).

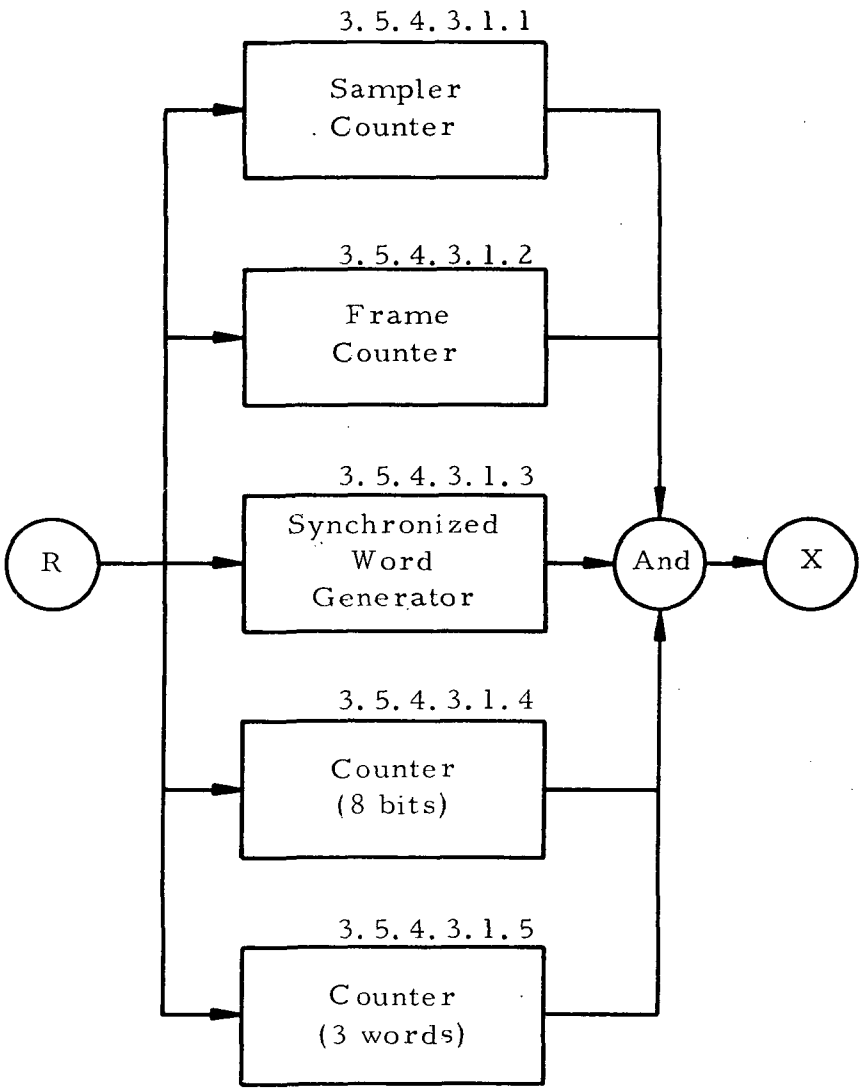


FIGURE Q-1. EXPERIMENT T-013, CREW/VEHICLE DISTURBANCES FUNCTIONAL BLOCK DIAGRAM (Sheet 9 of 15)

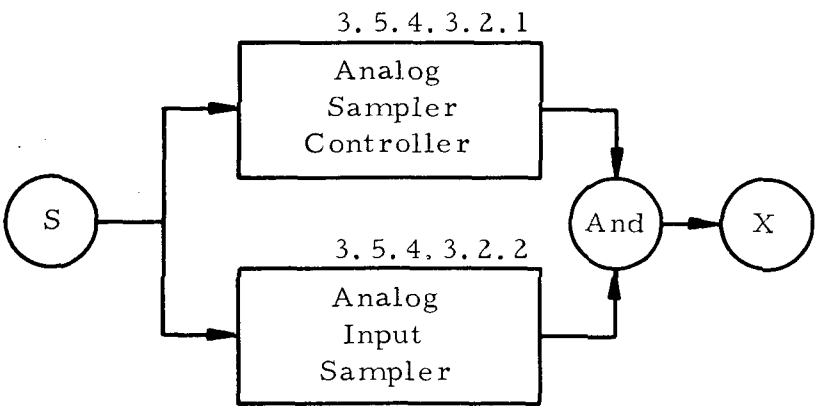


FIGURE Q-1. EXPERIMENT T-013, CREW/VEHICLE DISTURBANCES FUNCTIONAL BLOCK DIAGRAM (Sheet 10 of 15)

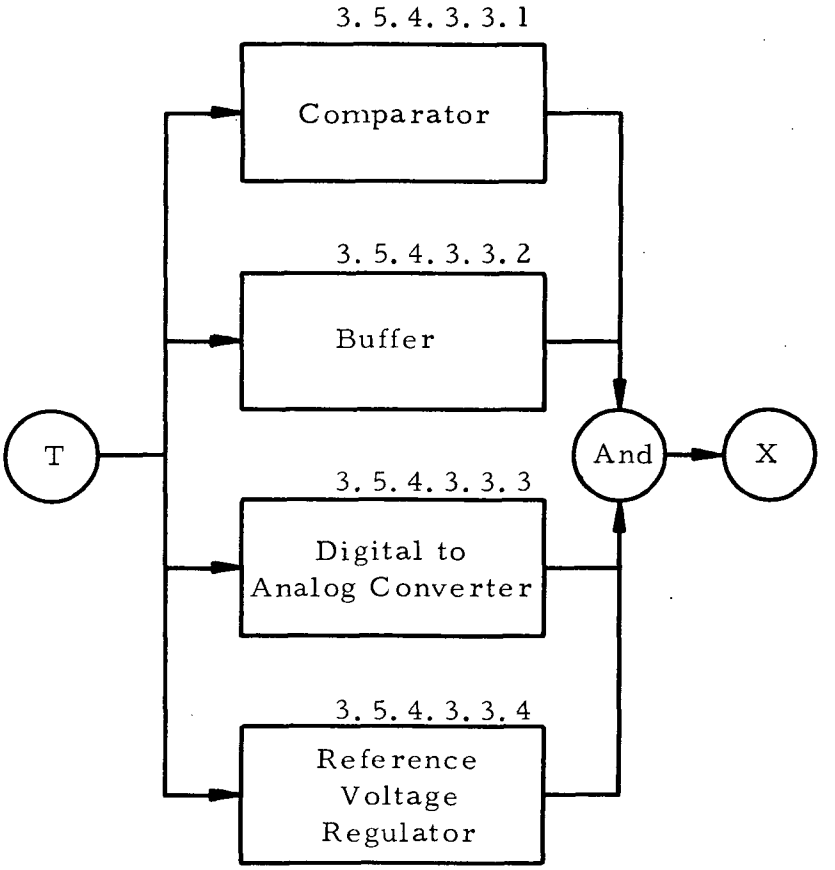


FIGURE Q-1. EXPERIMENT T-013, CREW/VEHICLE DISTURBANCES FUNCTIONAL BLOCK DIAGRAM (Sheet 11 of 15)

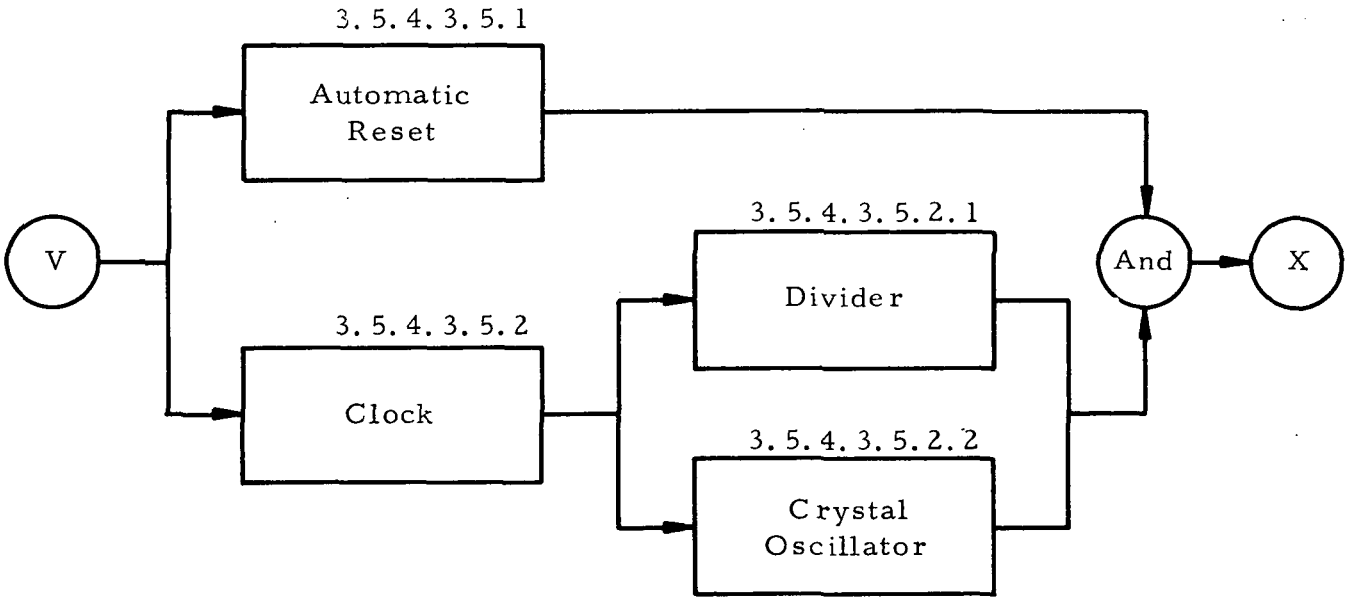


FIGURE Q-1. EXPERIMENT T-013, CREW/VEHICLE DISTURBANCES FUNCTIONAL BLOCK DIAGRAM (Sheet 12 of 15)

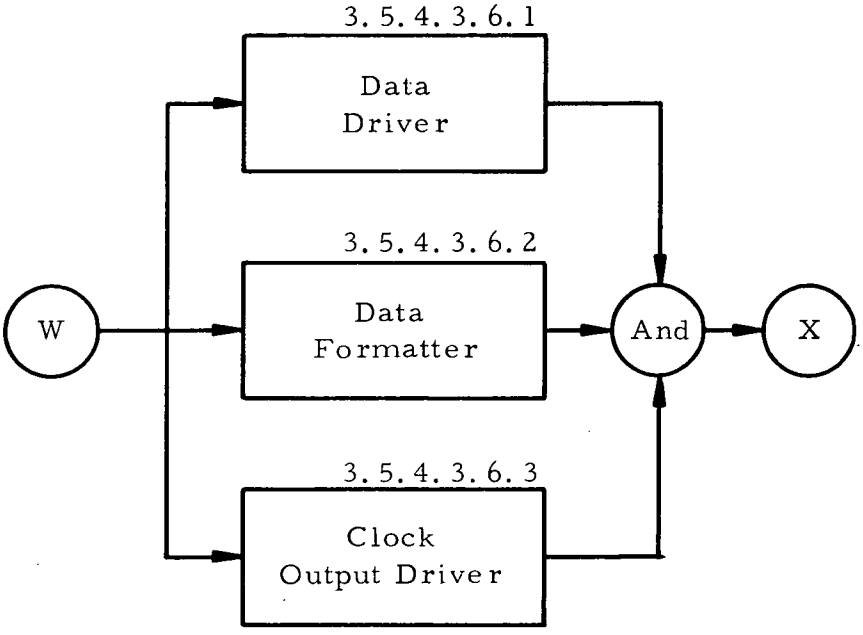


FIGURE Q-1. EXPERIMENT T-013, CREW/VEHICLE DISTURBANCES FUNCTIONAL BLOCK DIAGRAM (Sheet 13 of 15)

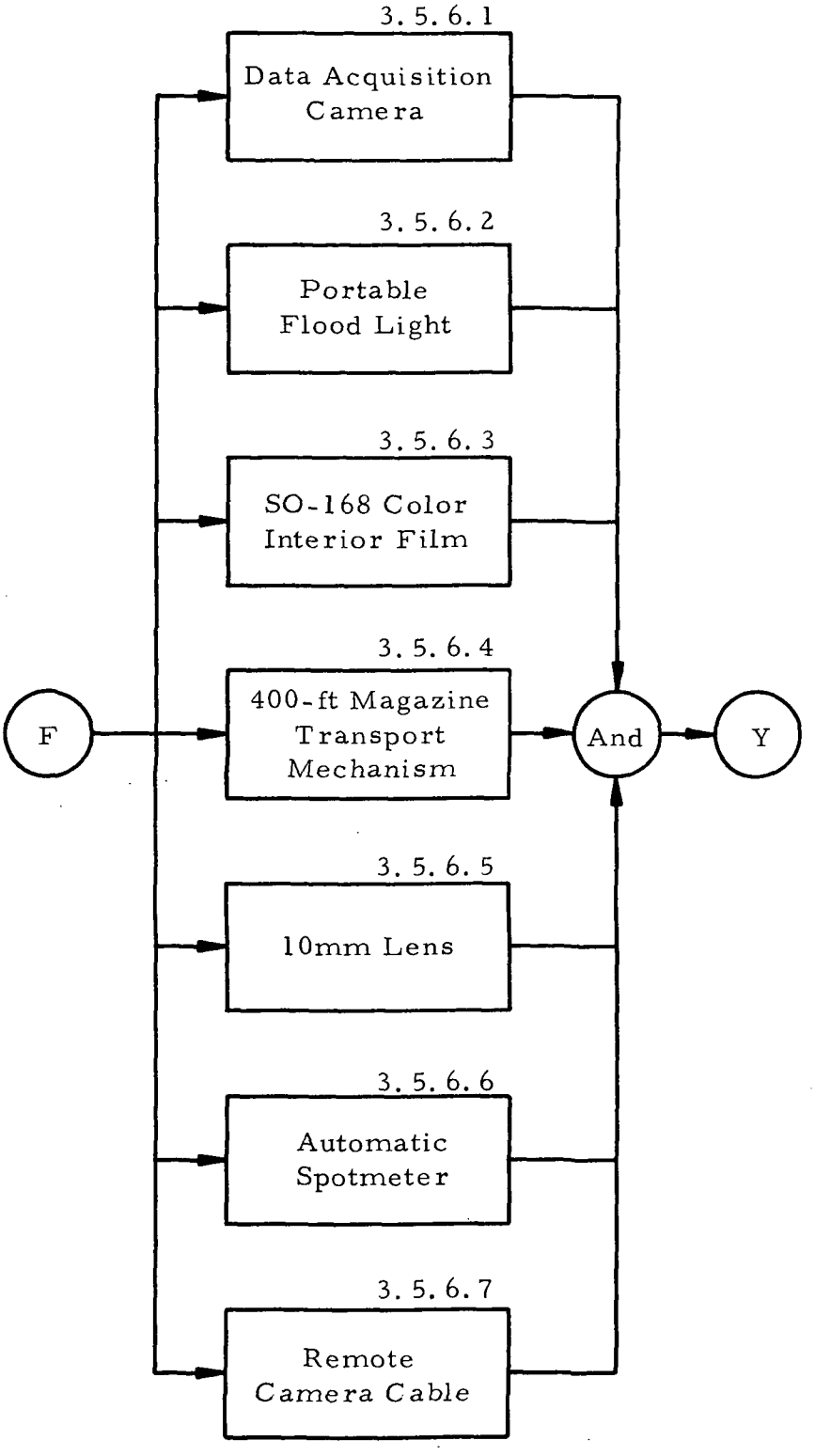


FIGURE Q-1. EXPERIMENT T-013, CREW/VEHICLE DISTURBANCES FUNCTIONAL BLOCK DIAGRAM (Sheet 14 of 15)

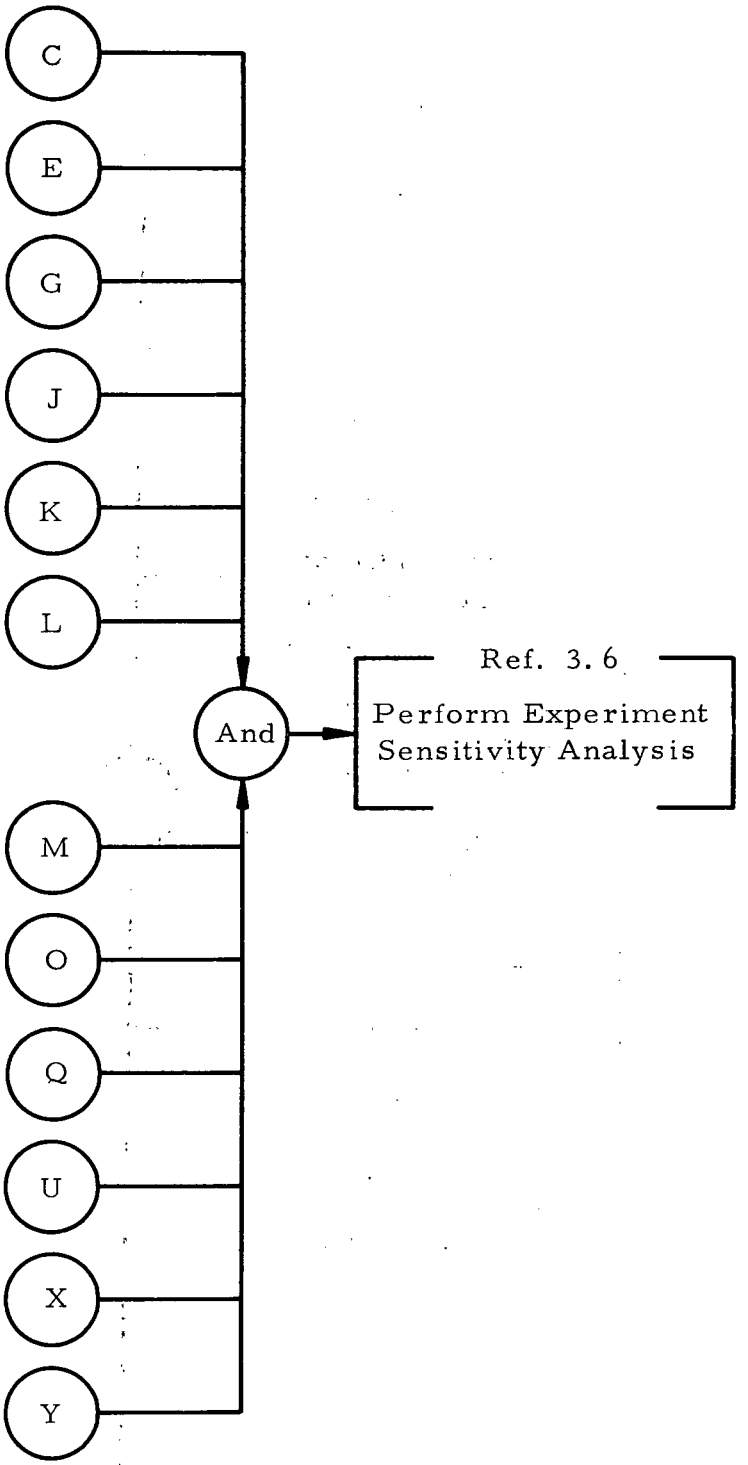
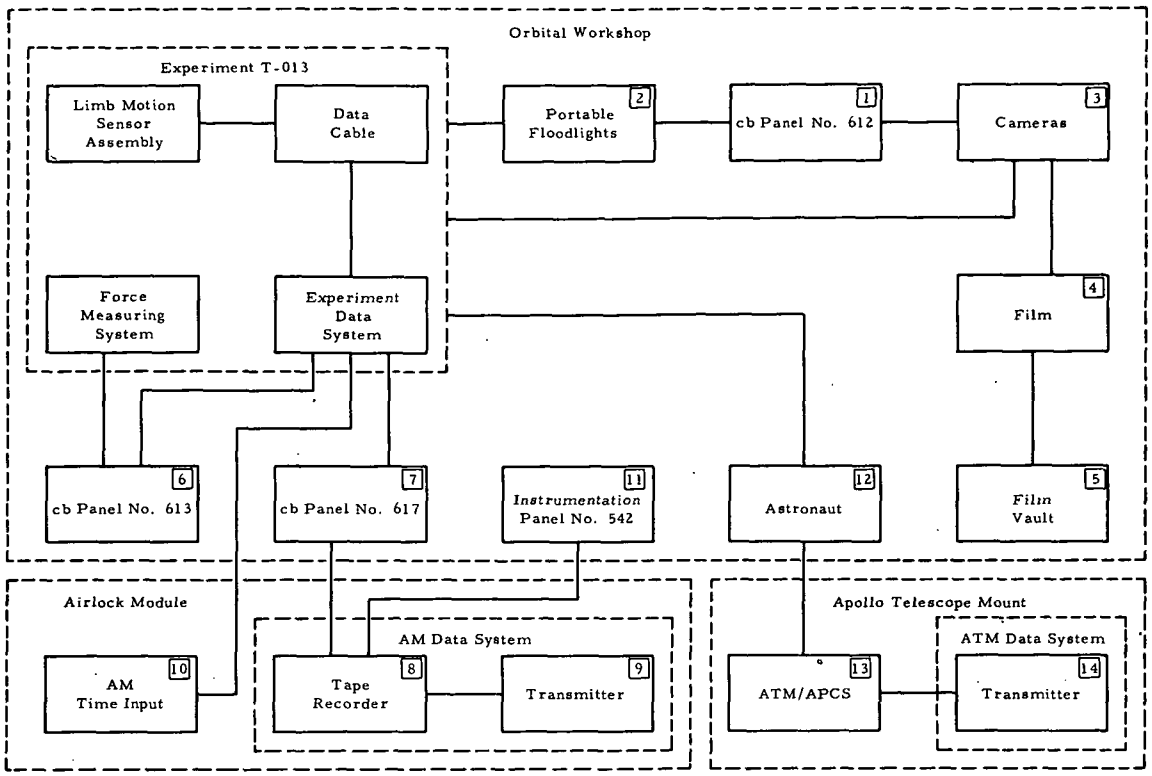


FIGURE Q-1. EXPERIMENT T-013, CREW/VEHICLE DISTURBANCES FUNCTIONAL BLOCK DIAGRAM (Sheet 15 of 15)

SECTION II.

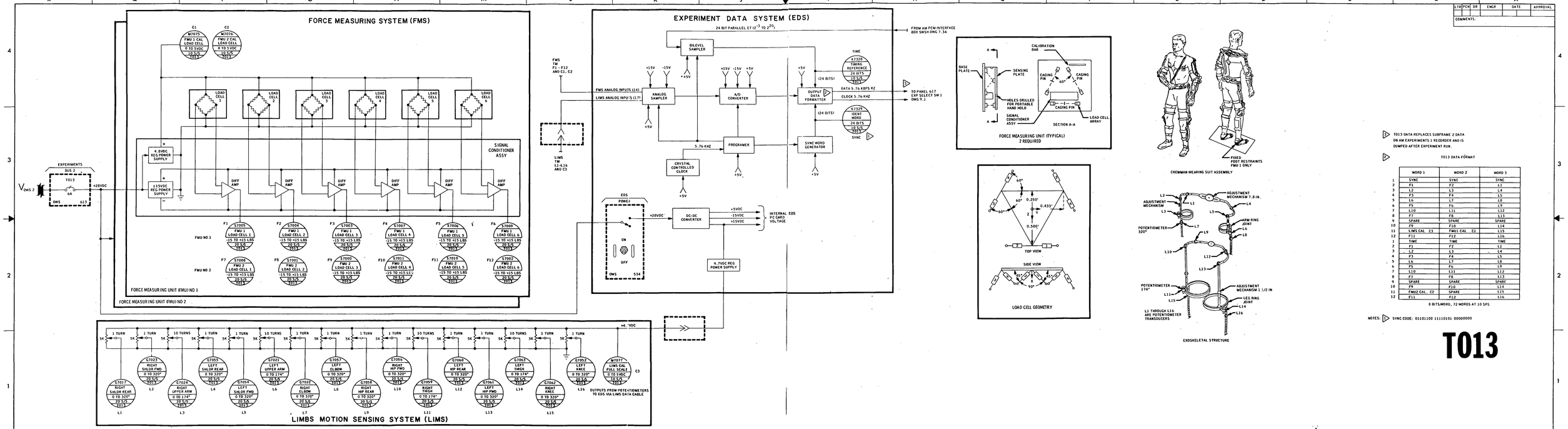
EXPERIMENT T-013, CREW/VEHICLE DISTURBANCES INTERFACE BLOCK DIAGRAM



Code	Data Source	Remarks
1	M7003-440 M7005-440 Crew	There is an electrical interface between the cb panel No. 612 and each of the following: portable floodlights and cameras. The cb panel No. 612 supplies power to the cameras and floodlights by way of utility outlets and high power accessory outlets.
2	Crew	There is a support interface between the portable floodlights and Experiment T-013. The floodlights will provide illumination for movie coverage of the test sequences.
3	Crew	There is a support interface between the two Data Acquisition Cameras (DAC) and Experiment T-013. The DAC's and film, Reference Code 4, will provide film coverage of the test sequences.
4	Crew and Return Film	There is a support interface between the film and Experiment T-013. Each of the two DAC's will use one 400-ft magazine loaded with color interior film, SO-168.
5	Crew	There is a support interface between the film vault and the film. The film vault will provide environmental protection for the film when not in use.
6	Crew	There is an electrical interface between cb panel No. 613 and each of the following: FMS and EDS. The cb panel No. 613 supplies power to the FMS and the EDS.
7	Crew	There is a communication and data interface between cb panel No. 617 and the EDS. The instrumentation portion of the panel is used during experiment operations to allow the tape recording of the EDS output data.
8	S7000T013 - S7011T013 G7021T013 - G7024T013 G7054T013 - G7063T013 G7017T013 G7052T013 M7075T013 - M7077T013 K7329T013	There is a communication and data interface between the AM tape recorders and the EDS. The data sources listed will be recorded at 5.76 kbits/sec on track A of the AM tape recorders.
9	Refer to Code 8.	There is a communication and data interface between the AM tape recorders and the OWS transmitter. The data stored on the AM tape recorders will be dumped to ground receivers by the AM Data System transmitter.
10	K7328T013	There is a data interface between the AM time input and the EDS. The AM time input is used to time correlate the data from the EDS with the ATM/APCS and movie coverage of the experiment.
11	Crew	There is an electrical interface between Instrumentation Panel No. 542 and the AM tape recorders. Panel No. 542 provides remote operation of the AM tape recorders from the OWS forward compartment.
12	Crew	There is an operability interface between the astronauts and Experiment T-013. There is a pointing and control interface between the astronauts and the ATM/APCS. As the astronaut performs various experiment tasks, his movements are monitored by the experiment equipment and sent to the AM data system for tape recording and transmission. The effects of these astronaut motions on the OWS are sensed by the ATM/APCS and transmitted real time.
13	R015-702 - R031-702 G023-702 - G028-702 M529-702 - M532-702 M164-702 - M165-702 G037-702 - G038-702 K382-702	Refer to Code 12.
14	Refer to Code 13.	Refer to Code 12.

SECTION III.

EXPERIMENT T-013, CREW/VEHICLE DISTURBANCES
SYSTEMS DIAGRAM



T013 DATA REPLACES SUBFRAME 2 DATA ON AM EXPERIMENTS 2 RECORDER AND IS DUMPED AFTER EXPERIMENT RUN.

T013 DATA FORMAT

	WORD 1	WORD 2	WORD 3
1	SYNC	SYNC	SYNC
2	F1	F2	L1
3	L2	L3	L4
4	F3	F4	L5
5	L6	L7	L8
6	F5	F6	L9
7	L10	L11	L12
8	F7	F8	L13
9	SPARE	SPARE	SPARE
10	F9	F10	L14
11	LIMS CAL C3	FMU1 CAL C1	L15
12	F11	F12	L16
1	TIME	TIME	TIME
2	F1	F2	L1
3	L2	L3	L4
4	F3	F4	L5
5	L6	L7	L8
6	F5	F6	L9
7	L10	L11	L12
8	F7	F8	L13
9	SPARE	SPARE	SPARE
10	F9	F10	L14
11	FMU2 CAL. C2	SPARE	L15
12	F11	F12	L16

8 BITS/WORD, 72 WORDS AT 10 SPS

NOTES: SYNC CODE: 01101100 11110101 00000000

LTR	PCN	DR	ENGR	DATE	APPROVAL

COMMENTS:

T013

FIGURE Q-3. EXPERIMENT T-013, CREW/VEHICLE DISTURBANCES SYSTEMS DIAGRAM

SECTION IV.

EXPERIMENT T-013, CREW/VEHICLE DISTURBANCES DATA REQUIREMENTS SUMMARY

TABLE Q-II. EXPERIMENT T-013, CREW/VEHICLE DISTURBANCES DATA REQUIREMENTS SUMMARY

Measurement Name	Range and Dimension of Variable	Measurement Number	Telemetry Assignment Channel	Data Return	Data Time	Remarks
POSIT-EXP T013, LMSS, ANG R SD RE	0 to 320°	G7017T013	WP2D006A01HT03	Analog	All Time	
POSIT-EXP T013, LMSS, ANG R SD FD	0 to 320°	G7023T013	WP2D007A01HT04	Analog	All Time	
POSIT-EXP T013, LMSS, ANG L SD FD	0 to 174°	G7024T013	WP2D008A01HT05	Analog	All Time	
POSIT-EXP T013, LMSS, ANG L SD RE	0 to 320°	G7055T013	WP2D009A01HT06	Analog	All Time	
POSIT-EXP T013, LMSS, ANG L SD FD	0 to 320°	G7054T013	WP2D012A01HT09	Analog	All Time	
POSIT-EXP T013, LMSS, ANG L UPR A	0 to 174°	G7021T013	WP2D013A01HT10	Analog	All Time	
POSIT-EXP T013, LMSS, ANG R ELBOW	0 to 320°	G7022T013	WP2D014A01HT11	Analog	All Time	
POSIT-EXP T013, LMSS, ANG L ELBOW	0 to 320°	G7057T013	WP2D015A01HT12	Analog	All Time	
POSIT-EXP T013, LMSS, ANG R HP RE	0 to 320°	G7058T013	WP2D018A01HT15	Analog	All Time	
POSIT-EXP T013, LMSS, ANG R HP FD	0 to 320°	G7056T013	WP2D019A01HT16	Analog	All Time	
POSIT-EXP T013, LMSS, ANG R THIGH	0 to 174°	G7059T013	WP2D020A01HT17	Analog	All Time	
POSIT-EXP T013, LMSS, ANG R HP RE	0 to 320°	G7060T013	WP2D021A01HT18	Analog	All Time	
POSIT-EXP T013, LMSS, ANG L HP FD	0 to 320°	G7061T013	WP2D024A01HT21	Analog	All Time	
POSIT-EXP T013, LMSS, ANG L THIGH	0 to 174°	G7063T013	WP2D030A01HT27	Analog	All Time	
POSIT-EXP T013, LMSS, ANG R KNEE	0 to 320°	G7062T013	WP2D033A01HT30	Analog	All Time	
POSIT-EXP T013, LMSS, ANG L KNEE	0 to 320°	G7052T013	WP2D036A01HT33	Analog	All Time	
STRAIN-EXP T013, FMU 1 LC 1	±15 lb	S7005T013	WP2D004A01HT01	Analog	All Time	
STRAIN-EXP T013, FMU 1 LC 2	±15 lb	S7004T013	WP2D005A01HT02	Analog	All Time	
STRAIN-EXP T013, FMU 1 LC 3	±15 lb	S7003T013	WP2D010A01HT07	Analog	All Time	
STRAIN-EXP T013, FMU 1 LC 4	±15 lb	S7007T013	WP2D011A01HT08	Analog	All Time	
STRAIN-EXP T013, FMU 1 LC 5	±15 lb	S7006T013	WP2D016A01HT13	Analog	All Time	
STRAIN-EXP T013, FMU 1 LC 6	±15 lb	S7009T013	WP2D017A01HT14	Analog	All Time	
STRAIN-EXP T013, FMU 2 LC 1	±15 lb	S7008T013	WP2D022A01HT19	Analog	All Time	
STRAIN-EXP T013, FMU 2 LC 2	±15 lb	S7001T013	WP2D023A01HT20	Analog	All Time	
STRAIN-EXP T013, FMU 2 LC 3	±15 lb	S7000T013	WP2D028A01HT25	Analog	All Time	
STRAIN-EXP T013, FMU 2 LC 4	±15 lb	S7011T013	WP2D029A01HT26	Analog	All Time	
STRAIN-EXP T013, FMU 2 LC 5	±15 lb	S7010T013	WP2D034A01HT31	Analog	All Time	
STRAIN-EXP T013, FMU 2 LC 6	±15 lb	S7002T013	WP2D035A01HT32	Analog	All Time	
VOLT-EXP T013, FMU 1, CAL LCB	0 to 5 Vdc	M7075T013	WP2C032A01HT29	Analog	All Time	
VOLT-EXP T013, FMU 2, CAL LCB	0 to 5 Vdc	M7076T013	WP2C067A01HT61	Analog	All Time	
VOLT-EXP T013, LMSS, CAL FULL SC	0 to 5 Vdc	M7077T013	WP2C031A01HT28	Analog	All Time	
Event-EXP T013, TIMING REFERENCE	N/A	K7328T013	WP2C037A01DT01	Digital	All Time	
Event-Exp T013, IDENT WORD	N/A	K7329T013	WP2C001A01ST01	Digital	All Time	
Rate, Outer Gimbal CMG No. 1	±6.8°/sec	R017-702	RP1B0-12L03-00	Analog	Real Time	
Rate, Outer Gimbal CMG No. 2	±6.8°/sec	R018-702	RP1B0-12L09-00	Analog	Real Time	

Continued on next page

TABLE Q-II. (Concluded)

Measurement Name	Range and Dimension of Variable	Measurement Number	Telemetry Assignment Channel	Data Return	Data Time	
Rate, Outer Gimbal CMG No. 3	±6.8°/sec	R019-702	RP1B0-17L03-00	Analog	Real Time	
Rate, Inner Gimbal CMG No. 1	±6.8°/sec	R020-702	RP1B0-12L04-00	Analog	Real Time	
Rate, Inner Gimbal CMG No. 2	±6.8°/sec	R021-702	RP1B0-12L10-00	Analog	Real Time	
Rate, Inner Gimbal CMG No. 3	±6.8°/sec	R022-702	RP1B0-17L04-00	Analog	Real Time	
Voltage, Yaw Fine Sun Sensor Command	±12 Vdc	M164-702	RP1B0-26L01-00	Analog	Real Time	
Voltage, Pitch Fine Sun Sensor Command	±12 Vdc	M165-702	RP1B0-26L02-00	Analog	Real Time	
Vehicle X Rate Gyro No. 1 Output	±1°/sec or ±0.1°/sec	R023-702	RP1B0-11L01-00	Analog	Real Time	
Vehicle Y Rate Gyro No. 1 Output	±1°/sec or ±0.1°/sec	R024-702	RP1B0-27L01-00	Analog	Real Time	
Vehicle Z Rate Gyro No. 1 Output	±1°/sec or ±0.1°/sec	R025-702	RP1B0-11L06-00	Analog	Real Time	
Vehicle X Rate Gyro No. 2 Output	±1°/sec or ±0.1°/sec	R026-702	RP1B0-27L02-00	Analog	Real Time	
Vehicle Y Rate Gyro No. 2 Output	±1°/sec or ±0.1°/sec	R027-702	RP1B0-11L04-00	Analog	Real Time	
Vehicle Z Rate Gyro No. 2 Output	±1°/sec or ±0.1°/sec	R028-702	RP1B0-11L02-00	Analog	Real Time	
Vehicle X Rate Gyro No. 3 Output	±1°/sec or ±0.1°/sec	R029-702	RP1B0-11L03-00	Analog	Real Time	
Vehicle Y Rate Gyro No. 3 Output	±1°/sec or ±0.1°/sec	R030-702	RP1B0-11L05-00	Analog	Real Time	
Vehicle Z Rate Gyro No. 3 Output	±1°/sec or ±0.1°/sec	R031-702	RP1B0-07L05-00	Analog	Real Time	
Angle, Inner Gimbal CMG No. 1	-80 to +80°	G023-702	RP1B0-12L01-00	Analog	Real Time	
Angle, Outer Gimbal CMG No. 1	-130 to +225°	G024-702	RP1B0-17L10-00	Analog	Real Time	
Angle, Inner Gimbal CMG No. 2	-80 to +80°	G025-702	RP1B0-12L07-00	Analog	Real Time	
Angle, Outer Gimbal CMG No. 2	-130 to +225°	G026-702	RP1B0-12L08-00	Analog	Real Time	
Angle, Inner Gimbal CMG No. 3	-80 to +80°	G027-702	RP1B0-17L01-00	Analog	Real Time	
Angle, Outer Gimbal CMG No. 3	-130 to +225°	G028-702	RP1B0-17L02-00	Analog	Real Time	
EPC Pitch Rate Gyro Command	-1 to +1°/sec	R015-702	RP1B0-21L04-00	Analog	Real Time	
EPC Yaw Rate Gyro Command	-1 to +1°/sec	R016-702	RP1B0-21L05-00	Analog	Real Time	
Voltage, A.S.S. Output, X Primary	-7.5 to +7.5°	M529-702	RP1B0-21L03-00	Analog	Real Time	
Voltage, A.S.S. Output, X Redundant	-7.5 to +7.5°	M530-702	RP1B0-12L05-00	Analog	Real Time	
Voltage, A.S.S. Output, Y Primary	-7.5 to +7.5°	M531-702	RP1B0-12L06-00	Analog	Real Time	
Voltage, A.S.S. Output, Y Redundant	-7.5 to +7.5°	M532-702	RP1B0-21L06-00	Analog	Real Time	
Angle, Outer Gimbal, Star Tracker	0 or 5 Vdc	G037-702		Digital	Real Time	Fifteen-bit digital word.
Angle, Inner Gimbal, Star Tracker	0 or 5 Vdc	G038-702		Digital	Real Time	Fifteen-bit digital word.
EPC System Resolver Output (Pitch and Yaw)	0 or 5 Vdc	K382-702		Digital	Real Time	Part of 50-bit ATM digital computer word.
Astronaut Voice Comments and Recording	N/A	N/A	N/A	N/A	N/A	
Log Book	N/A	N/A	N/A	N/A	N/A	
On-board TV (OWS)	TBD	N/A	N/A	N/A	Intermitt.	Real/All
On-board Timing (GMT)	TBD	K502-512	WP1A124A04D107 WP1A045A03D107 WP1A046A03D107 WP1A047A03D107	Event	Real	

SECTION V.

EXPERIMENT T-013, CREW/VEHICLE DISTURBANCES DATA REQUEST FORMS

DATA REQUEST FORM Skylab Program	DRF Control No.	Date 12/2/71
	Exp/Sys No ASTN-SD/OWS/T013-033	Revision

Mission	Period of Interest	Op. Need Date	Rev Date
SL-1/2, 3 & 4	Flt		

Request Contact	Data Recipient	Date Req
Name Organization Phone	Name Mr. W. R. Bock Address S&E-ASTN-SDF MSFC, Alabama 35812 Phone 205-453-3810	1

Reference Documents:

MRD Content

Detailed Requirements:

MOPS Format for Experiment T013

Provide MPOS format for the following parameters associated with the operation of experiment T013 Crew Vehicle Disturbances

Comments & Explanation:

Originator	Integrator
Name Mr. W. R. Bock Organization MSFC/S&E-ASTN-SDF Phone 205-453-3810 Signature Date	Name J. R. Riquelmy Organization S&E-ASTN-SDF Phone 205-453-3810 Signature Date
Request Approval	**Implementing Agency**
Name Organization Phone Signature Date	Name Organization Phone Signature Date

MSFC - Form 65 (October 1970)

DRF Control No.	Exp/Sys No. ASTN-SD/OWS/T013-033	Revision	Date 12/2/71

Detailed Requirements:

Meas. No.	Title
G7017 T013	Lims, Angle Right Shoulder Rear
G7021 T013	" " Left Upper Arm
G7022 T013	" " Right Elbow
G7023 T013	" " " Shoulder Forward
G7024 T013	" " " Upper Arm
G7052 T013	" " Left Knee
G7054 T013	" " " Shoulder Forward
G7055 T013	" " " " Rear
G7056 T013	" " Right Hip Forward
G7057 T013	" " Left Elbow
G7058 T013	" " Right Hip Rear
G7059 T013	" " " Thigh
G7060 T013	" " Left Hip Rear
G7061 T013	" " " " Forward
G7062 T013	" " Right Knee
G7063 T013	" " Left Thigh
S7000 T013	FMU #2, Load Cell #3
S7001 T013	" #2 " " #2
S7002 T013	" #2 " " #6
S7003 T013	" #1 " " #3
S7004 T013	" #1 " " #2
S7005 T 013	" #1 " " #1
S7006 T013	" #1 " " #5
S7007 T013	" #1 " " #4
S7008 T013	" #2 " " #1
S7009 T013	" #1 " " #6
S7010 T013	" #2 " " #5
S7011 T013	" #2 " " #4
K7328 T013	Event, Timing Reference
K7329 T013	" Identification Word
M7075 T013	Voltage, FMU #1 Calibration Bridge Reference
M7076 T013	" " #2 " " "
M7077 T013	" Lims Calibration Full Scale
G023 702	Angle, Inner Gimbal CMG #1
G024 702	" Outer " " #1
G025 702	" Inner " " #2
G026 702	" Outer " " #2
G027 702	" Inner " " #3
G028 702	" Outer " " #3
G037 702	" " " Star Tracker
G038 702	" Inner " " "

DRF Control No.	Exp/Sys No. ASTN-SD/OWS/T013-033	Revision	Date 12/2/71

Detailed Requirements:

Meas. No.	Title
K382 702	EPC System Resolver Output (Pitch and Yaw)
M164 702	Voltage, Yaw Fine Sun Sensor Command
M165 702	" Pitch " " " "
M529 702	" A.S.S. Output, X Primary
M530 702	" " " X Redundant
M531 702	" " " Y Primary
M532 702	" " " Y Redundant
R015 702	EPC Pitch Rate Gyro Command
R016 702	" Yaw " " "
R017 702	Rate Outer Gimbal CMG #1
R018 702	" " " " #2
R023 702	Vehicle X Rate Gyro #1 Output
R024 702	" Y " " #1 "
R025 702	" Z " " #1 "
R026 702	" X " " #2 "
R027 702	" Y " " #2 "
R028 702	" Z " " #2 "
R029 702	" X " " #3 "
R030 702	" Y " " #3 "
R031 702	" Z " " #3 "

DATA REQUEST FORM Skylab Program	DRF Control No.	Date 5-5-72
	Exp/Sys No. ASTN-SDI/OWS/T013	Revision

Mission	Period of Interest	Op. Need Date	Rev Date
SL-4	Flt		

Request Contact	Data Recipient	Date Req
Name Organization Phone	Name Mr. W. R. Bock Address S&E-ASTN-SDF Phone MSFC, Alabama 35812 205-453-3810	Qty 1

Reference Document: T-013 ERD, Exp. Operations Handbook

MRD Content

Detailed Requirements:

MOPS Format for Experiment T013

Provide MOPS format for the following parameter associated with the operation of experiment T013 Crew/Vehicle Disturbances.

MEAS. NO.	TITLE
M7003-440	Voltage-PDCS, OWS Bus 2

Comments & Explanation:

Originator	Integrator
Name Mr. B. B. Tonetti Organization Teledyne Brown Engr., ASD-SHI Phone 205-532-1561 Signature Date	Name J. R. Riquelmy Organization MSFC, S&E-ASTN-SDF Phone 205-453-3810 Signature Date
Request Aproval	**Implementing Agency**
Name Organization Phone Signature Date	Name Organization Phone Signature Date

MSFC - Form 65 (October 1970)

SECTION VI.

EXPERIMENT T-013, CREW/VEHICLE DISTURBANCES ENGINEERING CHANGE REQUESTS

No Engineering Change Requests for
Experiment T-013 are recommended.

SECTION VII.

EXPERIMENT T-013, CREW/VEHICLE DISTURBANCES EVALUATION SEQUENCE

TABLE Q-III. EXPERIMENT T-013, CREW/VEHICLE DISTURBANCES EVALUATION SEQUENCE (Sheet 1 of 10)

Assignments

Mission:

- SL-4

Orbital Assembly:

- OWS

Carrier:

- The two FMU's are located approximately at OWS Sta. No. 503.000 between quadrants II and III and III and IV. The EDS is located at OWS Sta. No. 437.997.

Conditions

Crew:

- Experiment T-013 requires the involvement of all three crewmen.
- One experiment performance is required.

Experiment:

- The Commander (CDR) and Pilot (PLT) function as experiment subject and observer, respectively.
- Total experiment time is 80 min: 34 min experiment preparation, 29 min operation, and 17 min post-operation.

Ground Support:

- None

Requirements

Functional Objectives:

- FO-1: Evaluate spacecraft disturbances caused by typical inflight crew motions.
- FO-2: Obtain ATM/APCS performance data in response to the crewmen's motions.
- FO-3: Verify ground-based simulation program data.

Experiment Evaluation Team-Key Personnel Locator

Name	Responsibility	Office Address, Symbol, and Telephone Number
Mr. B. Conway	Principal Investigator (PI)	Langley Research Center, Hampton, Virginia, 703-827-3016
Mr. H. Clarke	Experiment Developer (ED)	Langley Research Center, Hampton, Virginia, 703-827-3016
Mr. E. O. Walker	MSFC Experiment Manager (EM)	MSFC, Bldg. 4201, PM-SL-DP, 205-453-3183
Mr. J. W. Stokes	S&E Integration Engineer (IE)	MSFC, Bldg. 4610, S&E-ASTN-SMH, 205-453-3793
Mr. W. R. Bock	Technical Discipline Manager (TDM)	MSFC, Bldg. 4610, S&E-ASTN-SDF, 205-453-3810
Mr. B. B. Tonetti	Experiment Operations Engineer (EOE)	Teledyne Brown Engineering Company, Huntsville, Alabama, ASD-SHI, 205-532-156
Mr. G. Batiuk	Mission Operations Design Support (MODS)	Martin Marietta Corporation, Denver, Colorado, 303-794-3174
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TABLE Q-III. EXPERIMENT T-013, CREW/VEHICLE DISTURBANCES EVALUATION SEQUENCE (Sheet 2 of 10)

Operation Step Number*	Crewman**	Test Procedure	Evaluation (Check One)		See Contingency Plan Number	Remarks
			Satis-factory	Anom-aly		
P - 60 min	Experiment Evaluation Team manned and available. Contact Experiment T-013, Technical Discipline Manager, S&E-ASTN-SD: HOSC Telephone No. TBD, Astronautics Laboratory Telephone No. 205-453-3810.					
	Reference: Skylab Flight Plan SL-3, Summary Timeline, MSC-03625, latest revision, and Skylab Experiment Operations Handbook, Volume II: Experiment Operational Procedures, MSC-00924, MSC, latest revision.					
P - 10 min GMT 15:00 for SL-4	Commence experiment preparation.					
P 1.0	OPR	Preoperational System Checkout.				Either CDR or PLT may perform this procedure.
P 1.1		Begin minimum impulse stability mode (requires 10 to 15 min time to stabilize).				
P 1.2		Close T-013 cb panel No. 613.				
P 1.3		Place Control and Display panel No. 617 Experiment No. 1 selector in position H.				
P 1.4		Turn on power switch of EDS.				
P 1.5		On instrumentation panel 542, turn on Experiment No. 1 tape recorder switch.				
P 1.6	Uncage and calibrate FMU 1. (Non-repeatable, unknown force applied to FMU)					
P 1.6.1		Remove 3 caging pins from caging mechanism.				
P 1.6.2		Secure caging pins in stowage hole in "A" frames.				
P 1.6.3		Raise calibration handle to stop.				
P 1.6.4		Return calibration handle to stowage position after 5 sec.				
P 1.6.5		Repeat Operation Step Nos. P 1.6.3 and P 1.6.4.				
P 1.7		For FMU 1, insert caging pins into caging mechanisms.				
P 1.8		Repeat Operation Step Nos. P 1.6 and P 1.7 for FMU 2.				

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TABLE Q-III. EXPERIMENT T-013, CREW/VEHICLE DISTURBANCES EVALUATION SEQUENCE (Sheet 3 of 10)

Operation Step Number*	Crewman**	Test Procedure	Evaluation (Check One)		See Contingency Plan Number	Remarks
			Satis-factory	Anom-aly		
P 1.9		Turn off power switch on EDS.				
P 1.10		On panel 542, turn Experiment No. 1 tape recorder off.				
P 1.11		Open cb panel No. 613.				
P 2.0	OPR	Photographic Equipment Preparation.				Either CDR or PLT may perform this procedure.
P 2.1		Set up 2 DAC's and high intensity lights per photo PAD update.				
P 3.0		Hardware Preparation				
P 3.1	SUB	Unstow T-013 LIMS suit and data cable from LIMS stowage container.				
P 3.2	SUB	Temporarily stow data cable as required.				
P 3.3	SUB/OBS	Subject dons LIMS suit.				
P 3.4	SUB	Unstow LIMS data cable.				
P 3.5	SUB	Remove tethered dust cover from EDS LIMS connector.				
P 3.6	SUB	Connect data cable to LIMS.				
P 3.7	SUB	Secure cable tether to suit "D" ring.				
P 3.8	OBS	Verify that cb panel No. 613 is open.				
P 3.9	SUB	Connect data cable to EDS and secure cable tether to EDS "D" ring.				
P 3.10	OBS	Close cb panel No. 613.				
P 3.11	OBS	Place Experiment No. 1 mode selector switch in position H.				
P 3.12	SUB	Turn EDS power switch on.				

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TABLE Q-III. EXPERIMENT T-013, CREW/VEHICLE DISTURBANCES EVALUATION SEQUENCE (Sheet 4 of 10)

Operation Step Number*	Crewman**	Test Procedure	Evaluation (Check One)		See Contingency Plan Number	Remarks
			Satis-factory	Anom-aly		
P 3.13	OBS	Obtain and attach portable handhold to the FMU without foot restraints.				
P 3.14	OBS	Don, connect communication carrier to speaker intercom system, and establish communications.				
P 3.15	OBS	On instrumentation panel 542, turn Experiment No. 1 tape recorder on.				
P 3.16	OBS	Uncage and calibrate FMU 1. Refer to Operation Step No. P 1.6.				
P 3.17	OBS	Repeat Operation Step No. P 3.16 for FMU 2.				
P 3.18	OBS	Turn on cb panel No. 612 for power to 2 DAC's and high intensity lights.				
O 1.0		Commence Experiment Operations.				
O 1.1	OBS	Announce the start of Experiment T-013 to ground personnel.				No cluster maneuvers are to be executed and all other crew activities are to be halted while this experiment is in progress.
O 1.2	OBS	Voice record subject ID, Task ID, and Operation Step No. at the beginning of each of the following experiment tasks: • Restrained movements on FMU 1 and free soaring between FMU's. • Switch simulations. • Worst case control system input tasks.				The OBS will announce the task by step number and the subject will perform the maneuver.

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TABLE Q-III. EXPERIMENT T-013, CREW/VEHICLE DISTURBANCES EVALUATION SEQUENCE (Sheet 5 of 10)

Operation Step Number*	Crewman**	Test Procedure	Evaluation (Check One)		See Contingency Plan Number	Remarks
			Satis-factory	Anom-aly		
O 1.3		Restrained movements on FMU 1 and free soaring between FMU's.				
O 1.3.1	SUB	Position feet in FMU 1 restraint.				
O 1.3.2	OBS	Time correlation sequence: • Knock on FMU 2 at approximate center of sense plate.				The OBS will stabilize himself at FMU 2 with free hand grasping FMU base plate or FMU mounting bracket (do not grasp sense plate). Care should be exercised to prevent obstruction of view for both cameras. This sequence will permit time correlation between the film data and T-013 telemetry data.
O 1.3.2.1		Knock 4 times at 1 sec intervals with 9 in. hand travel.				
O 1.3.2.2		Knock 3 times at 1/2 sec intervals with 5 in. hand travel.				
O 1.3.2.3		Knock 4 times at 2 sec intervals with 14 in. hand travel.				
O 1.3.2.4		Remain stationary at FMU 2 during subject's exercises.				
O 1.3.3	SUB	Respiration exercises, FMU 1.				After each of the following exercises, the SUB should stabilize for approximately 5 sec.
O 1.3.3.1		Breathe deeply for 15 sec, 40 to 45 breaths per min.				
O 1.3.3.2		Cough 5 times at 5 to 6 sec intervals.				
O 1.3.3.3		Simulate sneezing 5 to 6 times at 5 to 6 sec intervals.				
O 1.3.4	SUB	Arm exercise, FMU 1.				

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TABLE Q-III. EXPERIMENT T-013, CREW/VEHICLE DISTURBANCES EVALUATION SEQUENCE (Sheet 6 of 10)

Operation Step Number*	Crewman**	Test Procedure	Evaluation (Check One)		See Contingency Plan Number	Remarks
			Satis-factory	Anom-aly		
O 1.3.4.1		Perform 3 single pendulum right arm movements in the frontal plane, 8 to 10 sec apart.				Arm is straight and rigid at side. Raise it out to 90° from side and return.
O 1.3.4.2		Perform 3 single pendulum right arm movements in the sagittal plane, 8 to 10 sec apart.				Arm is straight and rigid at side. Raise it out in front of body 90° and return.
O 1.3.4.3		Perform 3 double pendulum left arm movements in the frontal plane, 8 to 10 sec apart.				Raise arm straight out to side (palm up). Bend elbow and move forearm toward shoulder through an angle of 150°. Return arm to side.
O 1.3.4.4		Perform 3 single pendulum right arm movements in the sagittal, transverse, and frontal planes, 8 to 10 sec apart.				Arm is straight and rigid at side. Raise arm 90° out in front of body, swing it through 90° to a position straight out to right side, and lower arm to side.
O 1.3.4.5		Perform 3 simultaneous frontal, transverse, and sagittal plane movements with both arms (single pendulums), 8 to 10 sec apart.				Starting with both arms at side, raise them simultaneously straight out from each side. Swing them through 90° to straight out in front of body; lower both arms to side simultaneously.
O 1.3.4.6		Perform 3 double pendulum left arm movements in the sagittal plane, 8 to 10 sec apart.				Raise arm straight out in front of body (palm up). Bend elbow and move forearm toward shoulder through angle of 150°. Return arm to side.
O 1.3.5	SUB	Bend upper body forward (0 to 80°) at waist 3 times, 10 to 12 sec apart.				

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TABLE Q-III. EXPERIMENT T-013, CREW/VEHICLE DISTURBANCES EVALUATION SEQUENCE (Sheet 7 of 10)

Operation Step Number*	Crewman**	Test Procedure	Evaluation (Check One) Satisfactory	Evaluation (Check One) Anomaly	See Contingency Plan Number	Remarks
O 1.3.6	SUB	Leg exercises, FMU 1.				
O 1.3.6.1		Remove right foot from restraint and stabilize.				
O 1.3.6.2		Perform 3 single pendulum right leg movements in the frontal plane, 10 to 12 sec apart.				Leg straight and rigid. Raise it out to side through an angle of 35 to 45° and return.
O 1.3.6.3		Perform 3 single pendulum right leg movements in the sagittal plane, 10 to 12 sec apart.				Leg is straight and rigid. Raise it out in front of body through an angle of 35 to 45° and return.
O 1.3.7	SUB	Soaring				OBS assists subject as required.
O 1.3.7.1		Release left foot from restraint and assume position for free soaring. Push off from FMU 1 and soar to FMU 2.				
O 1.3.7.2		Stabilize with hands only. Position feet on FMU 2 and push off to FMU 1.				
O 1.3.7.3		Stabilize with hands only. Push off FMU 1 with hands and land feet first on FMU 2.				
O 1.3.7.4		Push off FMU 2 with hands and return to FMU 1.				
O 1.3.8	OBS	Announce to the ground personnel that this portion of experiment tasks is completed.				
O 1.4	SUB	Perform switch simulations.				The OBS assists the SUB if necessary. This sequence will be performed over continental U.S. in order to obtain maximum real-time coverage of ATM/APCS data. Pause 5 to 10 sec between each simulation.

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TABLE Q-III. EXPERIMENT T-013, CREW/VEHICLE DISTURBANCES EVALUATION SEQUENCE (Sheet 8 of 10)

Operation Step Number*	Crewman**	Test Procedure	Evaluation (Check One)		See Contingency Plan Number	Remarks
			Satis-factory	Anom-aly		
O 1.4.1		Attach self to FMU 1 using foot restraints.				
O 1.4.2		Simulate actuating switches with right hand.				
O 1.4.3		Simulate rotating selector switch with right hand.				
O 1.4.4		Simulate actuating switches with right hand.				
O 1.4.5		Simulate hand controller operations with left hand.				
O 1.4.6		Simulate actuating switches with right hand.				
O 1.4.7		Simulate keyboard entry with left hand.				
O 1.4.8		Simulate nulling sequence with hand controller; sequence right and left nul controller with right hand.				
O 1.4.9		Simulate yaw inputs on hand controller with right hand.				
O 1.4.10		Simulate keyboard entry with left hand.				
O 1.4.11		Simulate yaw inputs on hand controller with right hand.				
O 1.4.12		Simulate keyboard entry with left hand.				
O 1.4.13		Simulate pitch inputs on hand controller with right hand.				
O 1.4.14		Simulate kayboard entry with left hand.				
O 1.4.15		Simulate actuating switches with right hand.				
O 1.4.16	OBS	Announce task completed.				
O 1.5		Conduct worst case control system input tasks.				This sequence must be performed over continental U.S. in order to maximize real-time coverage of ATM/APCS data.

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TABLE Q-III. EXPERIMENT T-013, CREW/VEHICLE DISTURBANCES EVALUATION SEQUENCE (Sheet 9 of 10)

Operation Step Number*	Crewman**	Test Procedure	Evaluation (Check One)		See Contingency Plan Number	Remarks
			Satis-factory	Anom-aly		
O 1.5.1	OBS	Verify Manned Space Flight Network (MSFN) acquisition.				
O 1.5.2	SUB	Fixed position exercises.				
O 1.5.2.1		Position feet in FMU 1 restraints.				
O 1.5.2.2		Move both arms rapidly up and down through an angle of 90° in the frontal plane, for 20 to 30 sec.				
O 1.5.2.3		Repeat above arm movements.				
O 1.5.2.4		Crouch and straighten body quickly as in a soaring push-off. Perform 5 or 6 times; stabilize each time.				Total time is 30 to 40 sec.
O 1.5.3	SUB	Soaring.				
O 1.5.3.1		Remove feet from restraints.				
O 1.5.3.2		Push off forcefully from FMU 1 and soar to FMU 2.				
O 1.5.3.3		Push off forcefully from FMU 2 and soar to FMU 1.				
O 1.5.3.4		Repeat soaring steps 4 times, as rapidly as practical.				Total time is 30 to 40 sec.
O 1.5.4		Worst Case.				Provides worst case APCS crew motion input.
O 1.5.4.1	OBS	Translate to food lockers.				
O 1.5.4.2	SUB	Push off from FMU 1 and soar to FMU 2. Push off from FMU 2 and soar to FMU 1.				
O 1.5.4.3	OBS	Simultaneously soar from food locker to film vault and return.				
O 1.5.4.4	SUB/OBS	Repeat Operation Step Nos. O 1.5.4.2 and O 1.5.4.3 quickly 3 times.				

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TABLE Q-III. EXPERIMENT T-013, CREW/VEHICLE DISTURBANCES EVALUATION SEQUENCE (Sheet 10 of 10)

Operation Step Number*	Crewman**	Test Procedure	Evaluation (Check One)		See Contingency Plan Number	Remarks
			Satis-factory	Anom-aly		
T 1.0		Equipment Stowage				
T 1.1	OBS	Announce that Experiment T-013 has been completed.				
T 1.2	SUB	Calibrate FMU 1: Raise calibration handle bar to stop and return to stowage position after 5 sec.				
T 1.3	SUB	Cage FMU 1: Insert caging pins into caging mechanisms.				
T 1.4	SUB	Repeat Operation Step Nos. T 1.2 and T 1.3 for FMU 2.				
T 1.5	OBS	Turn off 2 DAC's.				
T 1.6	OBS	Doff and stow communcation carrier.				
T 1.7	OBS	Turn Experiment No. 1, tape recorders off on panel No. 542.				
T 1.8	SUB	Turn EDS power off.				
T 1.9	OBS	Turn off high intensity lights on panel No. 612.				
T 1.10	OBS	Open T-013 cb panel No. 613.				
T 1.11	SUB	Disconnect LIMS data cable and tethers.				
T 1.12	SUB	Attach dust covers to data cable connectors and stow cable.				
T 1.13	OBS/SUB	Doff suit and stow per instructions on LIMS storage container cover.				
T 1.14	SUB	Close stowage container.				
T 1.15	SUB	Remove portable handhold and stow in E660.				
T 2.0		Photographic Equipment Stowage				
T 2.1	SUB	Stow photographic equipment per PAD update.				May be performed by CDR or PLT.

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SECTION VIII.

EXPERIMENT T-013, CREW/VEHICLE DISTURBANCES MALFUNCTION AND CONTINGENCY PLAN OUTLINE

TABLE Q-IV. EXPERIMENT T-013, CREW/VEHICLE DISTURBANCES MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT PREPARATION (P)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
P 1.6.1	Remove three caging pins from caging mechanism.	P161A Unable to remove caging pins from FMU.	P161A1 FMU is unusable, use other FMU for restrained motions.	
P 3.6	Connect data cable to LIMS.	P36A Unable to connect data cable to LIMS.	P36A1 Continue experiment with LIMS data loss.	
P 3.9	Connect data cable to EDS and secure cable tether to EDS "D" ring.	P39A Unable to connect data cable to EDS.	P39A1 (Reference P36A1)	
P 3.10	Close cb panel No. 613.	P310A T013 cb on Panel 613 fails open. P310B OWS BUS 2 failure.	P16A1 Loss of all EDS output. Experiment may still be performed using film coverage to correlate with ATM/APCS data.	Consider rescheduling experiment on latter mission.
P 3.11	Place Experiment No. 1 mode selector switch on Panel No. 617 in position H.	P311A Selector switch fails.	P311A1 (Reference P16A1)	
P 3.12	Turn EDS power switch on.	P312A EDS power switch fails open.	P312A1 (Reference P16A1)	
P 3.15	On instrumentation panel 542, turn Experiment No. 1 tape recorder on.	P315A Tape recorder switch fails.	P315A1 (Reference P16A1)	
P 3.18	Turn on cb panel No. 612 for power to 2 DAC's and high intensity lights.	P318A cb on panel No. 612 fails open.	P318A1 Loss of film data, continue experiment.	

P

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TABLE Q-V. EXPERIMENT T-013, CREW/VEHICLE DISTURBANCES MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT OPERATION (O)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
O 1.0	Commence experiment operations.	O10A Failure of one or more of the LIMS potentiometers or FMU load cells.	O10A1 Failure will be undetectable by the crew; continue experiment. Ground detection of failure may be recognized by off scale high or low output from AM tape dumps.	

TABLE Q-VI. EXPERIMENT T-013, CREW/VEHICLE DISTURBANCES MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT TERMINATION (T)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
	No contingency plans are anticipated for the Termination section of the experiment at this time.			

T

SECTION IX.

EXPERIMENT T-013, CREW/VEHICLE DISTURBANCES MALFUNCTION ANALYSES

Malfunction Analyses for Experiment T-013 are TBS.

SECTION X. CONCLUSIONS AND RECOMMENDATIONS

1. The success of Experiment T-013 is dependent on the correct data measurements by the FMS and the proper data collection, correlation, and transmission by the EDS. The logic and electronic components of the EDS are dependent on the proper performance of all subsystem components. If any of the subsystem components malfunction, then the EDS will not work properly and the experiment will be compromised.

2. The nature of the experiment used in Experiment T-013 does not allow the astronauts to detect any but the most obvious mechanical malfunctions. Because the output of the FMS and EDS is not available on a real time basis to the astronauts, they must depend upon ground interpretation of data to verify proper experiment operation.

3. The experiment equipment does not lend itself to contingency plans for correcting equipment malfunctions. There is little the astronauts can do to detect equipment malfunction or to initiate corrective action.

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