# TACTICAL DATA ACQUISITION EXPERIENCES

by

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## ABSTRACT

The requirements of Tactical Data Acquisition systems are discussed and summarized. Experiences with equipment and their utilization are described including: quantities measured, input signal conditioning, analogue multiplexing, analogue-to-digital conversion, digital formating, real-time accumulation, quick-look display, scaling and merging, recording, and analysis. Finally, an approach to future endeavours of this kind is presented.

## GENERALIZED TACTICAL SYSTEM

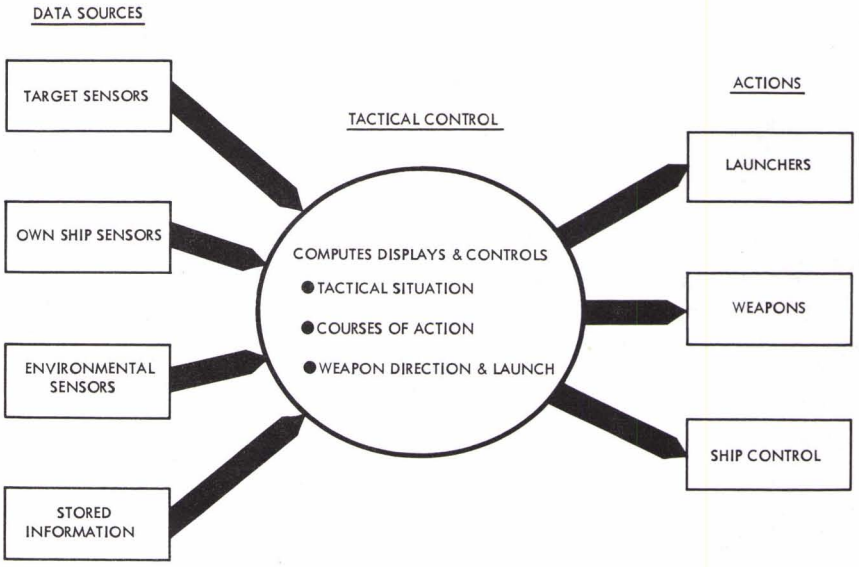



FIG. 1

## REQUIREMENTS OF A TYPICAL CURRENT TACTICAL DATA AQUISITION SYSTEM

| TYPES OF MEASUREMENT / QUANTITIES | TARGET(S) SENSOR(S) | | | | | | | | | | | | TACTICAL SUBSYSTEM | | | | | | | | | NAVIGATION SUBSYSTEM | | | | | | | | | | ENVIRONMENTAL | | | | RELATED | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | BEARING | ELEVATION | RANGE | RANGE RATE | S/N | STATUS & MODES | BEARING | RANGE | CAUSE | SPEED | RATES | WEAPON ORDERS | WEAPON SETTINGS | WEAPON SELECTIONS | LAUNCHER STATUS | STATUS & MODES | HEADING | SPEED | VELOCITY | LAT/LONG | PITCH | ROLL | DEPTH | STATUS | SOUND VELOCITY | WIND | SEA STATE | BOTTOM DEPTH | WEATHER | TARGET SHIP(S) | VEHICLE TRAJECTORIES | TIME SYNCHRONIZATION | REFERENCES | OPERATIONAL LOGS |
| DIGITAL | | | | | | ● | ● | ● | ● | ● | | | | | | | | | | | | | | | | | | | | | | | | | |
| SYNCHRO SIGNALS | ● | ● | ● | ● | | ● | ● | ● | ● | ● | ● | ● | | | | ● | ● | ● | ● | ● | ● | ● | | | | | | | | | | | | | |
| SYNCHRO REFERENCES | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | ● | | |
| A.C. SCALED VOLTAGES | | | | ● | | | | | | | ● | ● | | ● | | | | | | | | | | | | | ● | | | | | | | | |
| D.C. SCALED VOLTAGES | | | | ● | | | | | | | ● | ● | | ● | | | | | | | | | | | | | | | | | | | | | |
| A.C. & DC REFERENCE VOLTAGES | | | | | | | | | | | | | | ● | | | | | | | | | | | | | | | | | | | ● | | |
| STATUS VOLTAGES | | | | | ● | | | | | | ● | ● | ● | ● | ● | | | | | | | | ● | | | | | | | | | | | | |
| LOGIC LEVEL | | | | | | | | | | | ● | ● | ● | | | | | | | | | | ● | | | | | | | | | | | | |
| FREQUENCY | | | | | | | | | | | ● | ● | | | | | | | | | | | | | | | | | | | | | | | |
| TIME REFERENCE PULSE | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | ● | | | | |
| RECORDS | | | | | | | | | | | | | | | | | | | | | | | | ● | ● | ● | | ● | ● | ● | | | | ● | |

FIG. 2

## DATA MANAGEMENT

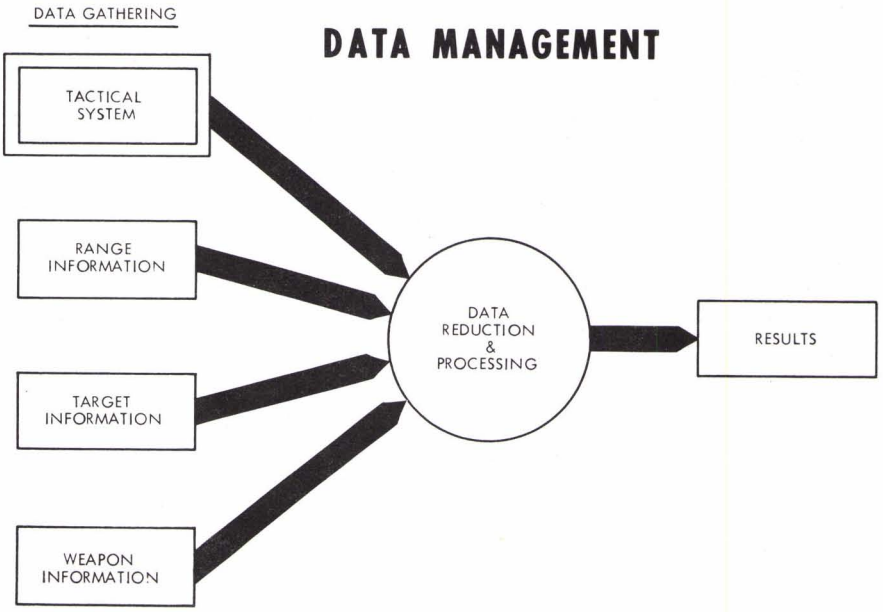



FIG. 3

# GENERALIZED DIGITAL DATA AQUISITION SYSTEM

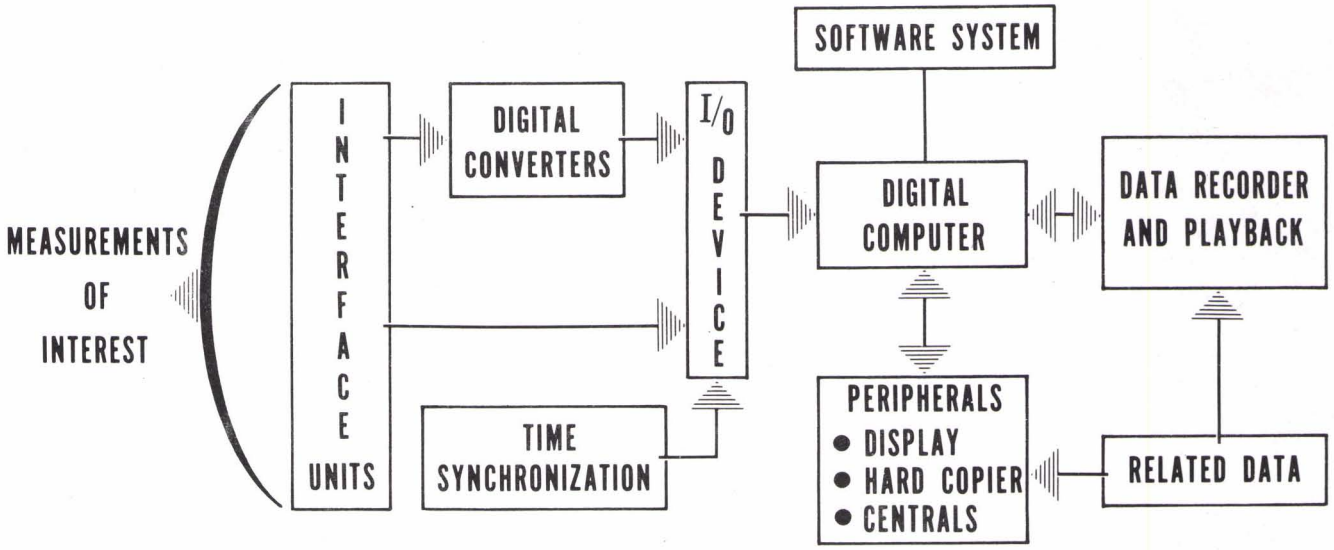
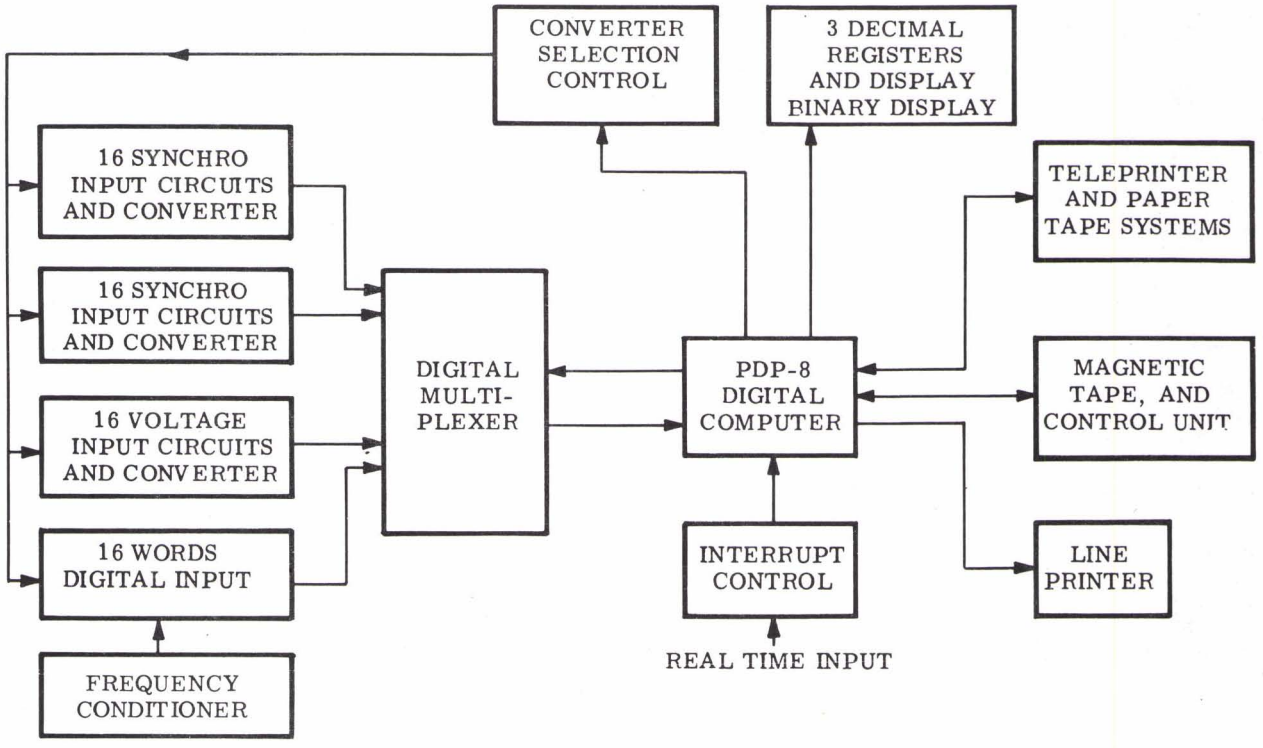



FIG. 4




# DIGITAL DATA ACQUISITION SYSTEM, FUNCTIONAL BLOCK DIAGRAM

FIG. 5

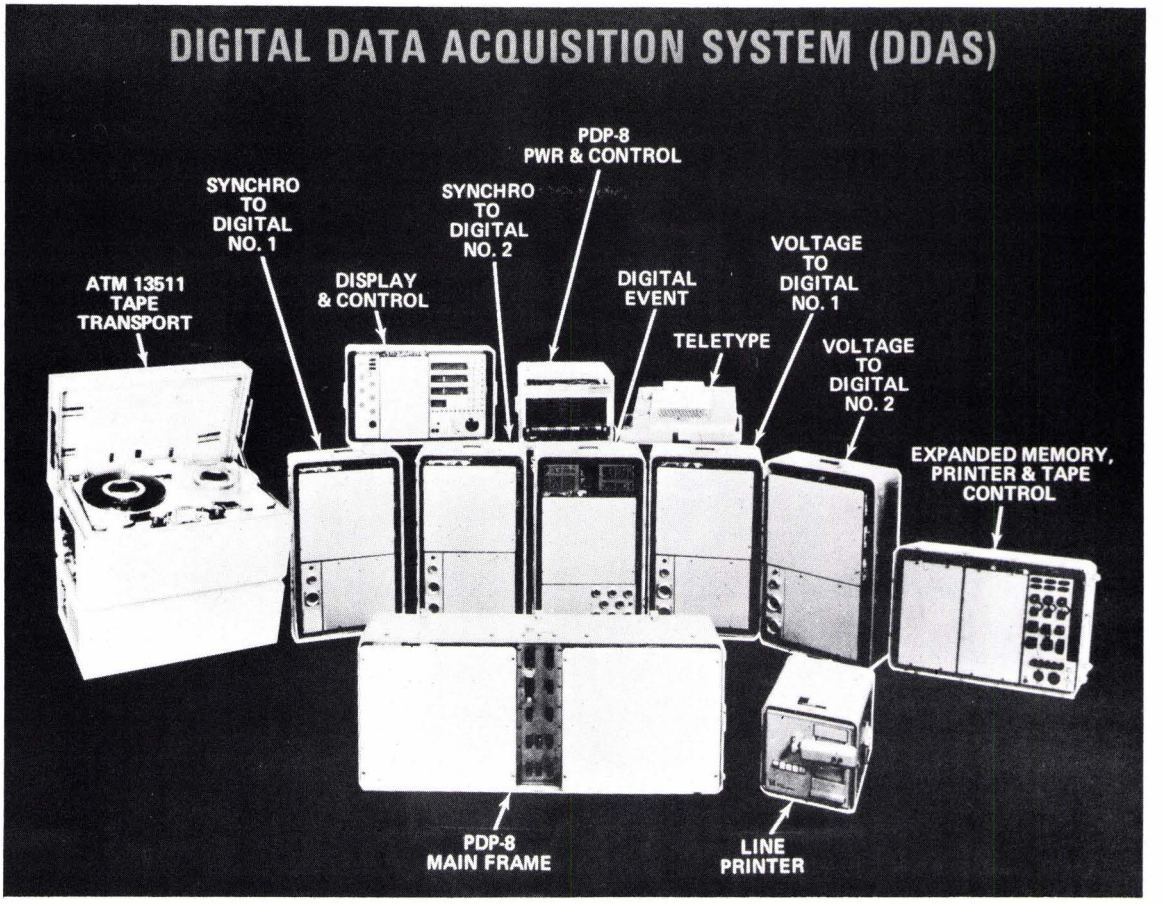
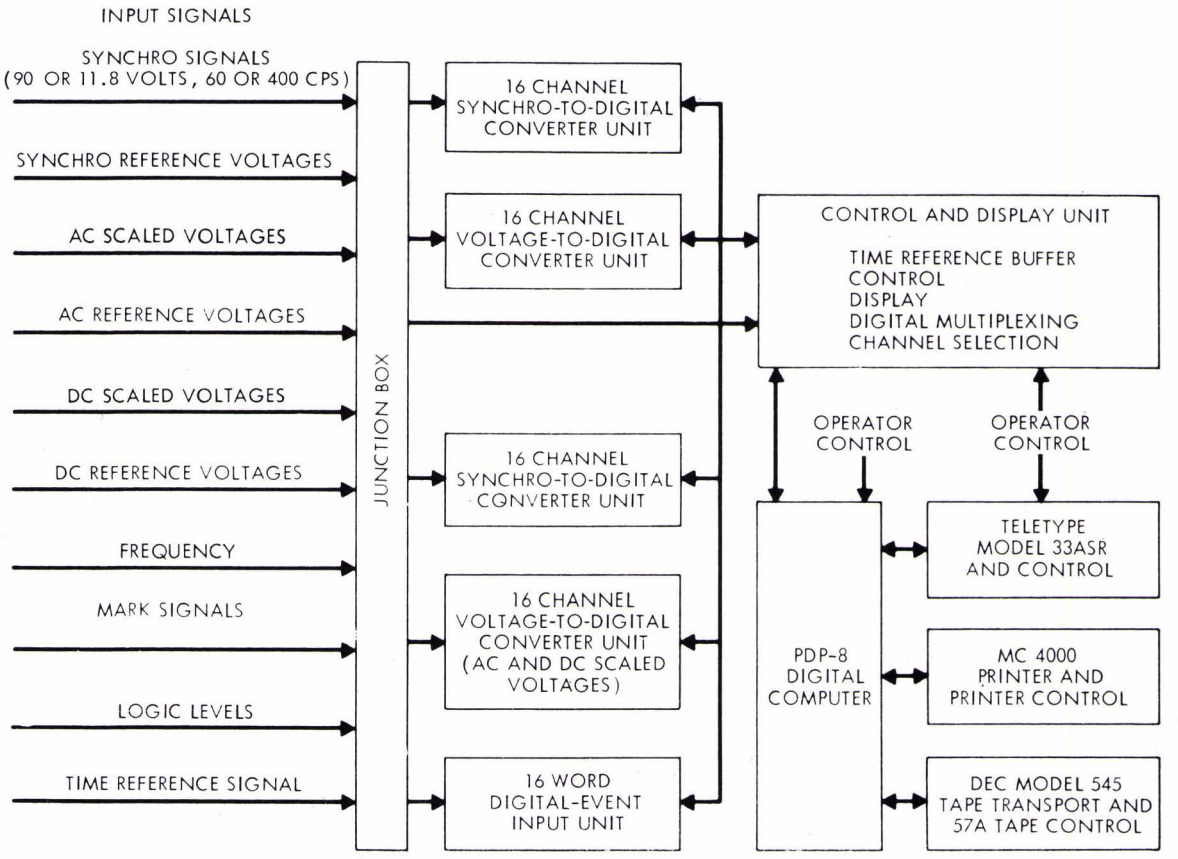


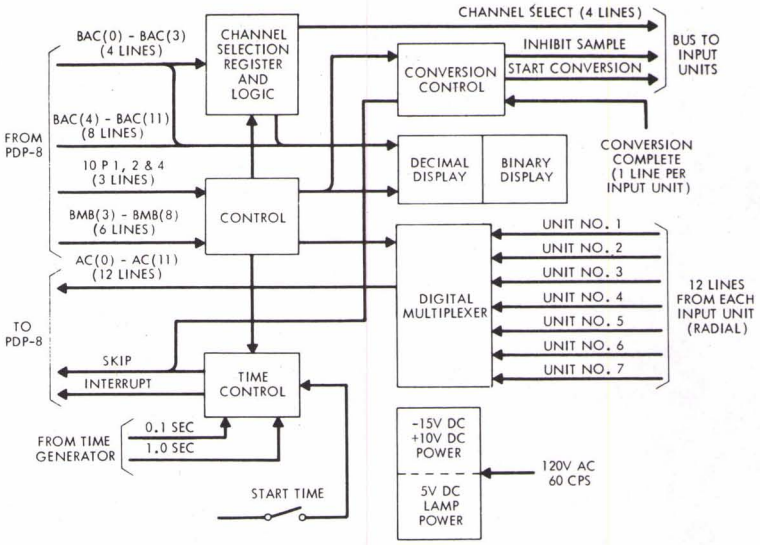

FIG. 6




**DDAS SYSTEM FUNCTIONAL BLOCK DIAGRAM (INITIAL VERSION)**

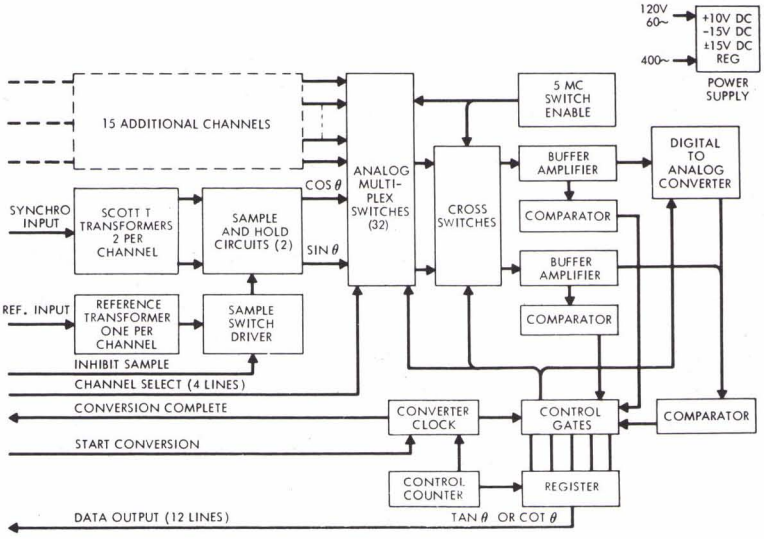
FIG. 7

FIG. 8



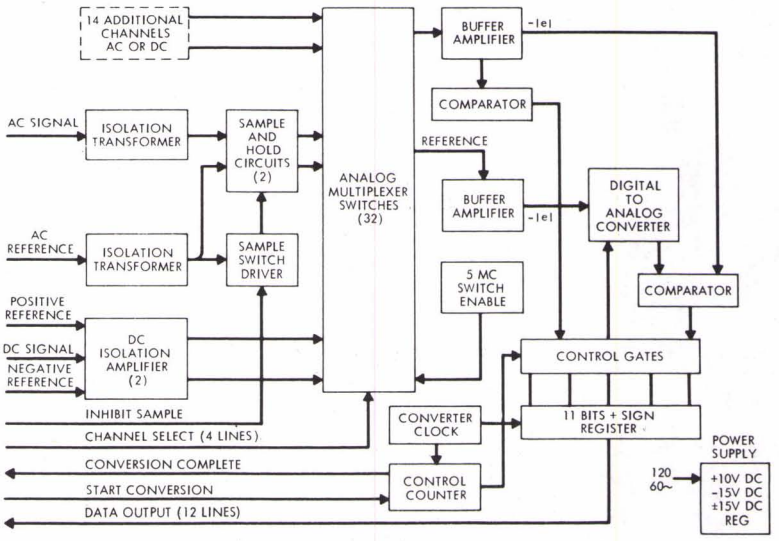

**DISPLAY AND CONTROL UNIT FUNCTIONAL BLOCK DIAGRAM**

FIG. 9

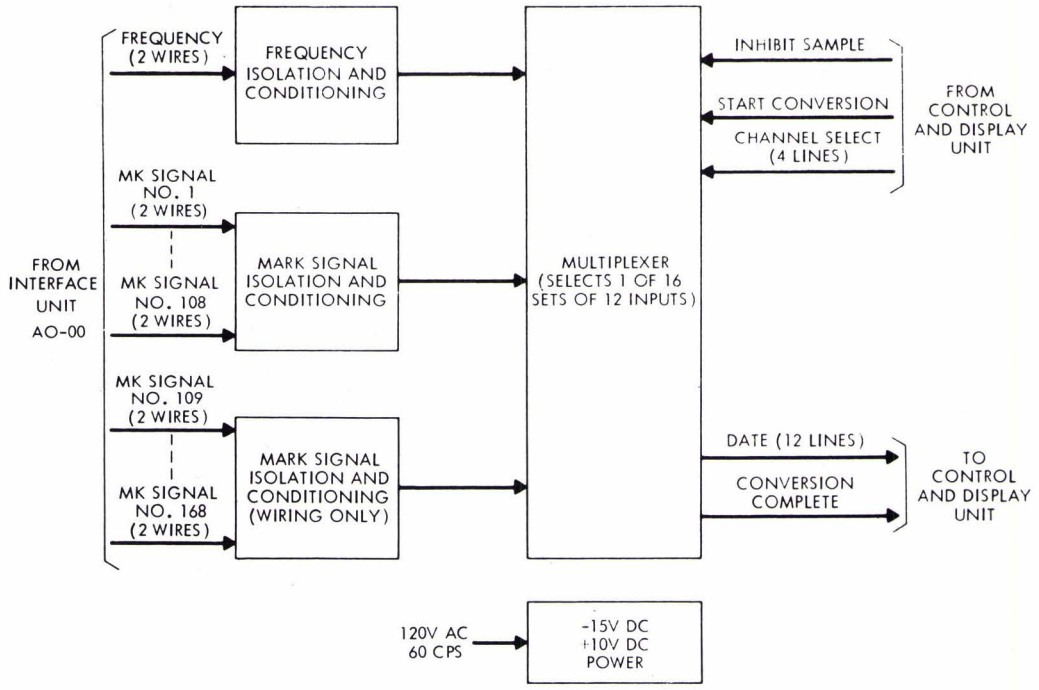



**SYNCHRO-TO-DIGITAL CONVERTER UNIT, FUNCTIONAL BLOCK DIAGRAM**

FIG. 10




**VOLTAGE-TO-DIGITAL CONVERTER UNIT, FUNCTIONAL BLOCK DIAGRAM**




**DIGITAL EVENT UNIT FUNCTIONAL BLOCK DIAGRAM**

FIG. 11

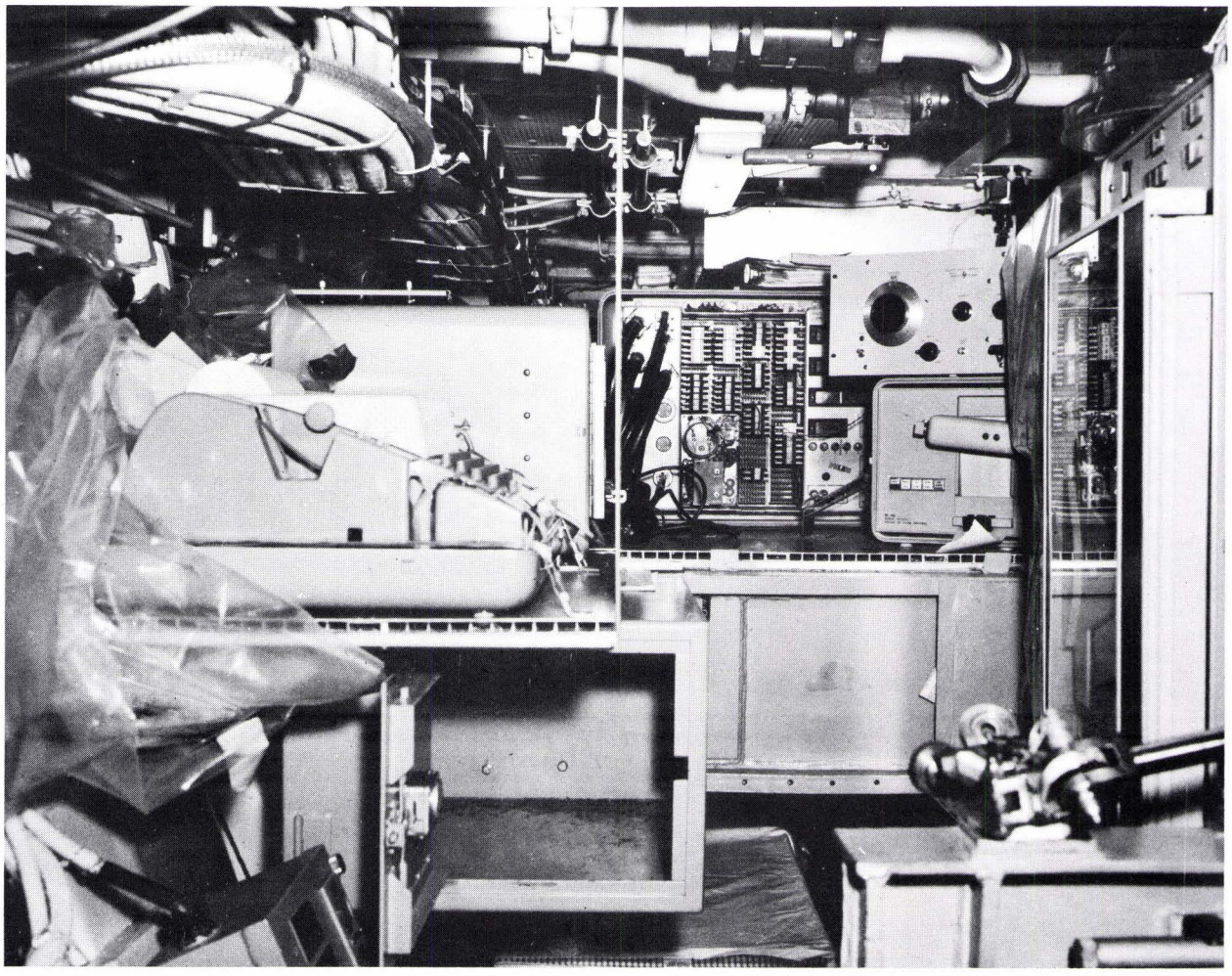


FIG. 12

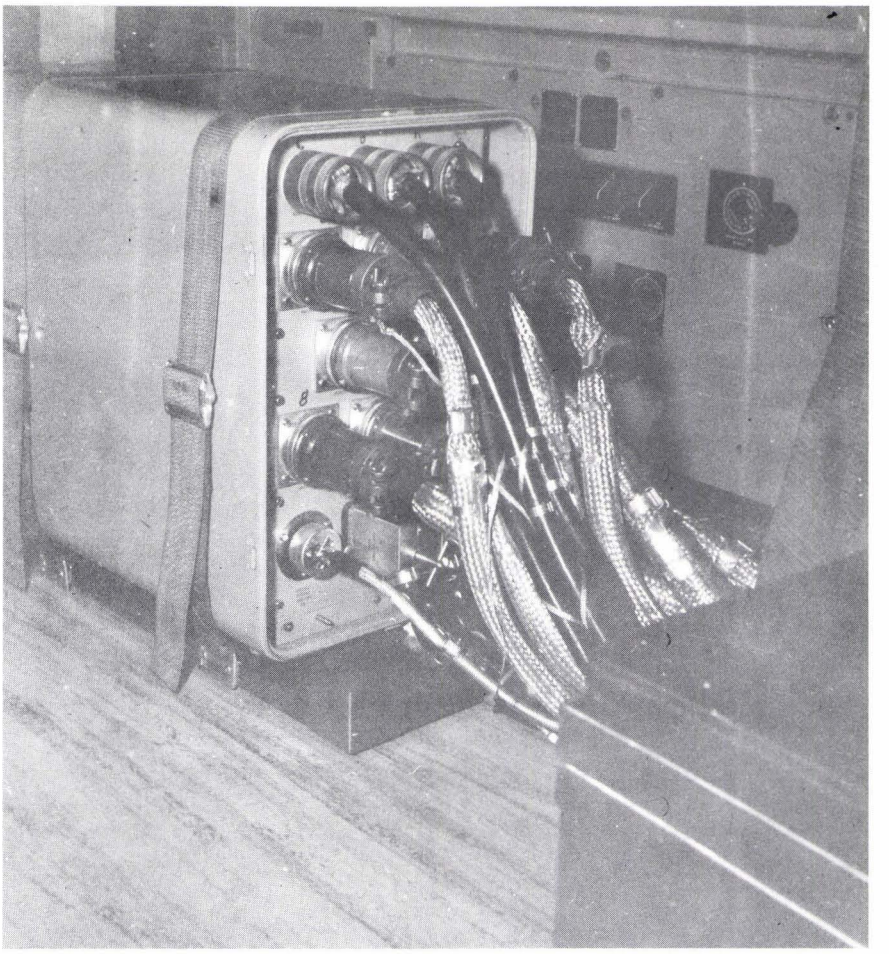


FIG. 13

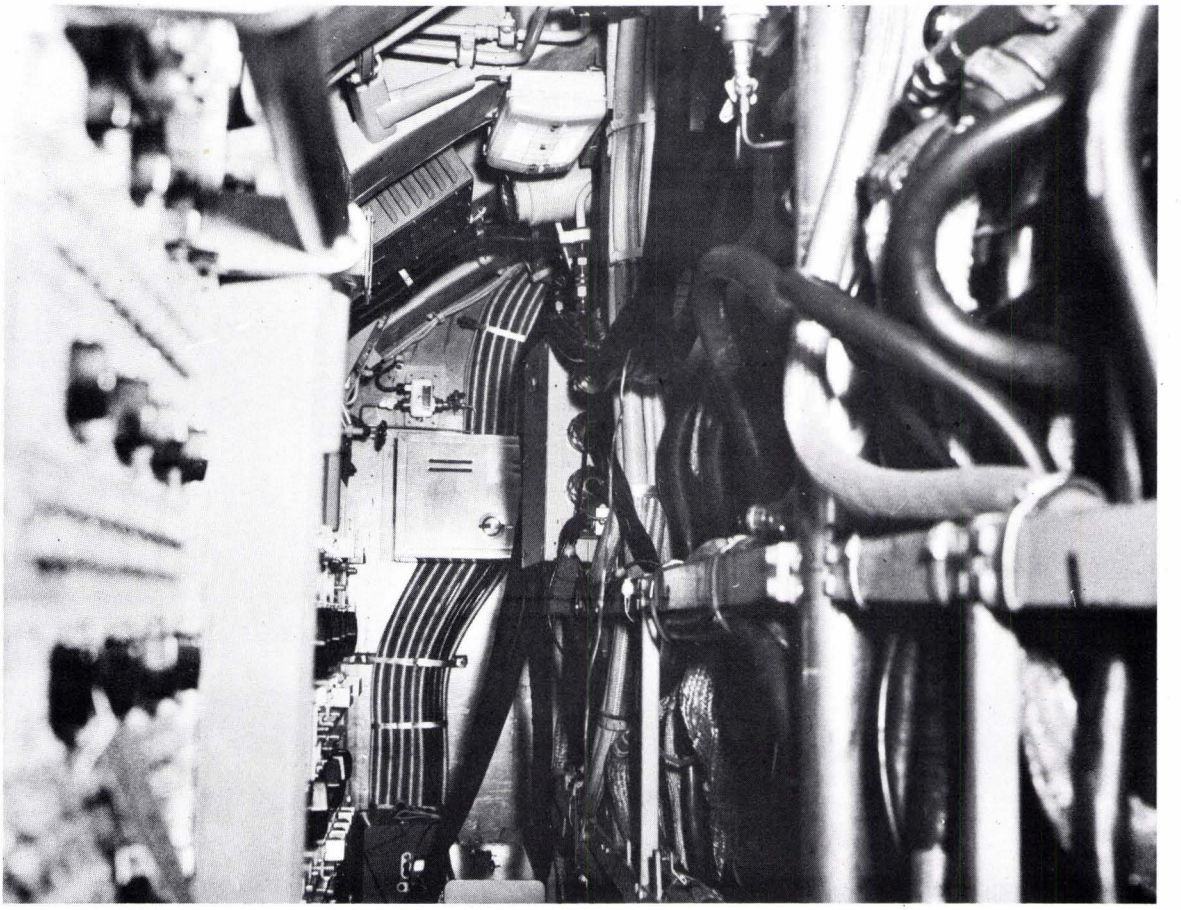


FIG. 14


SIMULATOR BOX

FIG. 15

## SUMMARY OF DIGITAL DATA ACQUISITION SYSTEM CHARACTERISTICS

SYNCHRO INPUTS

- UP TO 32 SINGLE SPEED CHANNELS
- 0.1 ACCURACY SINGLE SPEED
- 0.01 ACCURACY MULTIPLE SPEED

AC / DC SCALED VOLTAGE INPUTS

- UP TO 16 AC OR DC CHANNELS
- 0.05% RATIO ACCURACY

MARK SIGNAL INPUTS

- 8 MARK SIGNAL CHANNELS
- 0.1 SECOND MAXIMUM MARK SIGNAL TIMING ERROR

SAMPLE TIMES

- ALL FUNCTIONS SAMPLED WITHIN 0.001 SECOND
- MAXIMUM SAMPLE RATE 10 TIMES PER SECOND

OUTPUTS

- MAGNETIC TAPE: 7 TRACKS, DENSITIES (200, 556, 800), 3/4" SPACING
- PRINT OUT UP TO 32 ALPA NUMERIC COLUMNS (a) 40 LINES / SEC
  FOR SELECTIVE QUICK-LOOK
- SELECTIVE REAL-TIME DISPLAY: (3) 6 DIGIT DECIMAL + 3 DIGIT CHANNEL NO.
  (1) 12 BIT BINARY + 3 DIGIT CHANNEL NO.

ON-LINE CONTROL

FIG. 16

# DATA ACQUISITION SYSTEM HISTORY

| PROBLEMS EXPERIENCED | SOLUTIONS |
|---|---|
| INADEQUATE COMPUTER MEMORY | ADDED 4K MODULE |
| NON-INTEGRATED SOFTWARE | WITH ADDED MEMORY, INTEGRATION WAS POSSIBLE |
| TAPE INCOMPATIBILITY WITH LAND-BASED SYSTEM (SKEW) | CHANGED UNIT |
| EXCESSIVE SIZE | REPACKAGED PORTIONS |
| LOW OPERATIONAL CONFIDENCE | SYSTEM LEVEL TESTING |
| LONG INSTALLATION TIME | EXPERIENCE HAS REDUCED IT |
| INEFFICIENT ASSEMBLER COMPILER | USE MACHINE LANGUAGE |
| SLOW PROGRAM LOAD (PAPER TAPE) | USE OF MAG TAPE RECORDER |

FIG. 17

ATM-13 TAPE TRANSPORT

FIG. 18

# RECOMMENDATIONS FOR FUTURE ENDEAVORS

- EXPANDED ON-BOARD EDITING AND ANALYSIS CAPABILITY
  - > MORE POWERFUL COMPUTER, E. G., 16 BITS, HARDWARE MULTIPLY / DIVIDE, DOUBLE PRECISION, FLOATING POINT, ETC.
  - > RAW DATA COPYING CAPABILITY
  - > RECONFIGURABLE SOFTWARE
  - > CRT GRAPHICS DISPLAY FOR EDITING
  - > HARD COPY PLOTTER WITH ALPHA NUMERIC CAPABILITY
  - > MORE EFFICIENT COMPILER
- EXPANDED USE OF DIAGNOSTICS AND WELL DOCUMENTED MAINTENANCE TO INCREASE AVAILABILITY AND CONFIDENCE
- REDUNDANCY IN CRITICAL AREAS
- USE OF CRT GRAPHICS DISPLAY FOR EXPANDED QUICK-LOOK
- MINIATURIZATION
- RAPID SYSTEM LEVEL CHECKOUT

FIG. 19