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DEPARTMENT OF TRANSPORTATION
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Final Report, v.1.
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LINEAR INDUCTION MOTOR TEST VEHICLE DATA ANALYSIS PROGRAM;

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A Division of the Garrett Corporation,
Torrance Facility
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July 1971
Volume I: Program Description.

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Prepared for
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pt. 1

WDL Technical Report 4191
70 May 25

FINAL SYSTEM DESIGN REPORT

for the

LINEAR INDUCTION MOTOR VEHICLE DATA ACQUISITION SYSTEM

Submitted to

AIRESEARCH MANUFACTURING COMPANY
A Division of the Garret Corporation
Los Angeles, California

Contract No. C050-000-9

PHILCO-FORD CORPORATION
WDL Division
Palo Alto, California

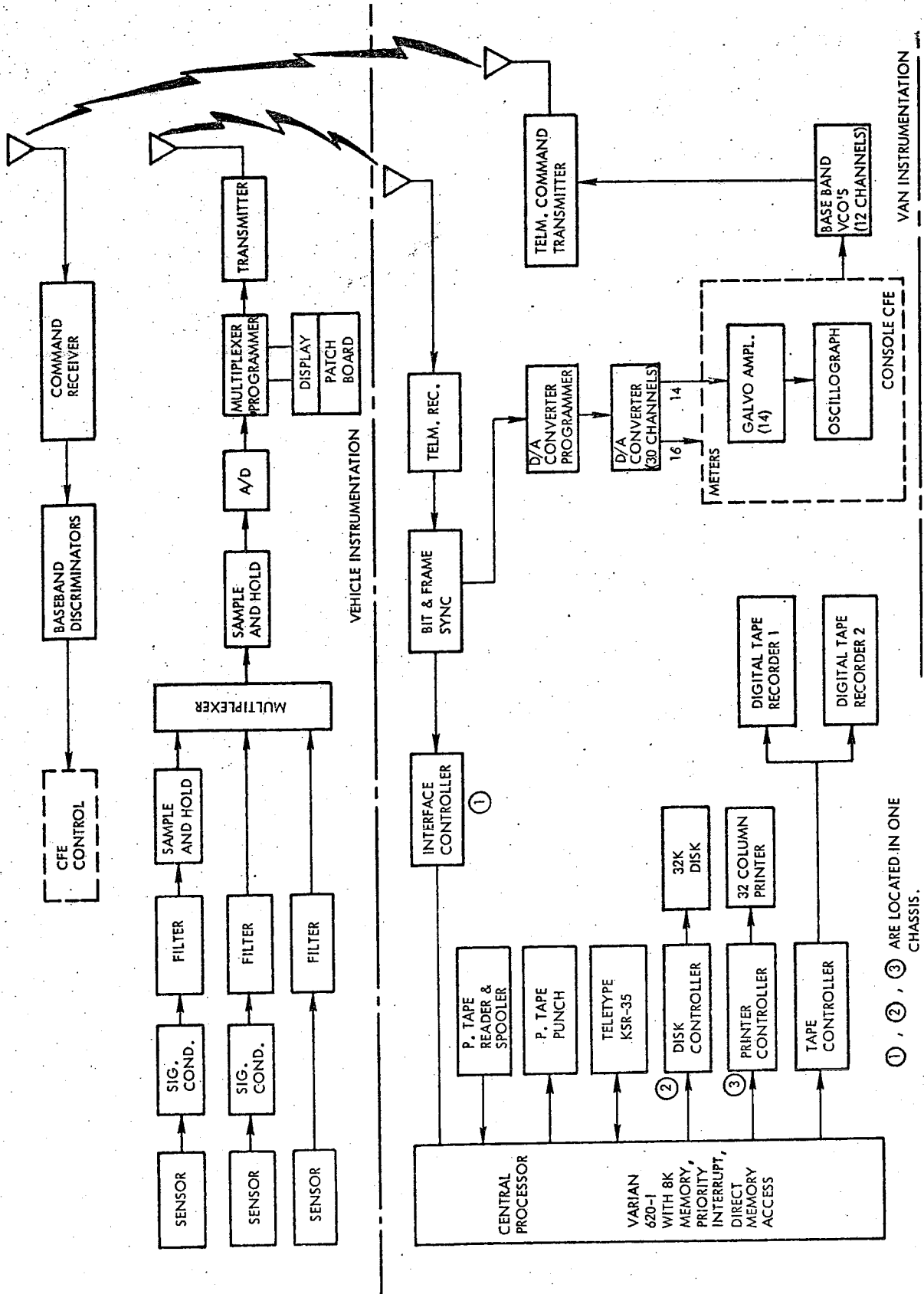


FIGURE 1-1 LIM DATA ACQUISITION AND CONTROL BLOCK DIAGRAM

The outputs at pins A4 and A6 of each of the 10 multiplexer modules are all commoned and connect to the two high speed sample-and-hold modules (HU-01). Unity gain operational amplifiers are used on each of the two sample-and-hold outputs to provide drive from the multiplexer chassis to the two analog-to-digital converters in the multiplexer programmer chassis.

2.5 SIGNAL CONDITIONING AMPLIFIER

The signal conditioning amplifier shown as a schematic in Figure 2-1 is an inverting operational amplifier. The circuit itself is self-explanatory but the following highlights are pointed out: Input 1 is the calibration terminal (gain of 1); input 2 is a gain of 1 terminal; input 3 is a gain of 0.555; and input 4 is a gain of 0.666.

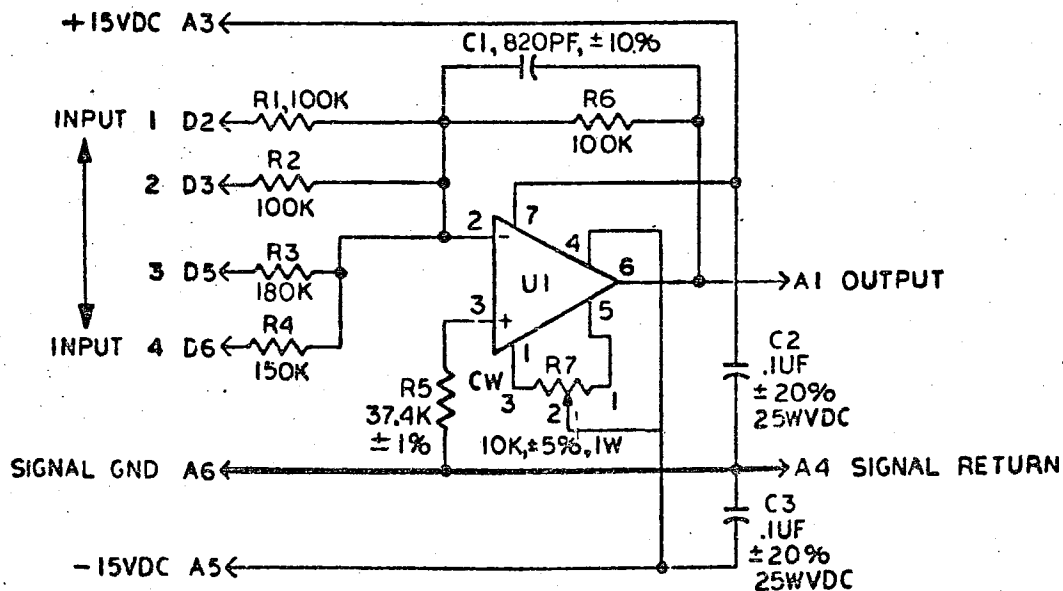


Figure 2-1 Signal Conditioning Amplifier

All gain determining resistors are 0.1 percent so that linearity and gain accuracy will not become a possible problem area. The capacitor "C1" is used to gain additional noise rejection in the system. The corner frequency is 2 kHz.

2.5 TEMPERATURE SENSING AMPLIFIER

The temperature sensing amplifier is shown schematically in Figure 2-2. Although the amplifier is connected in an operational configuration, as far as the bridge is concerned, it is connected for differential signals. With this technique it is possible to reject power errors that would result in common mode inputs to the amplifier. Using this technique and 0.1 percent resistors, it is possible to reject power supply misadjustments by approximately 100 to 1.

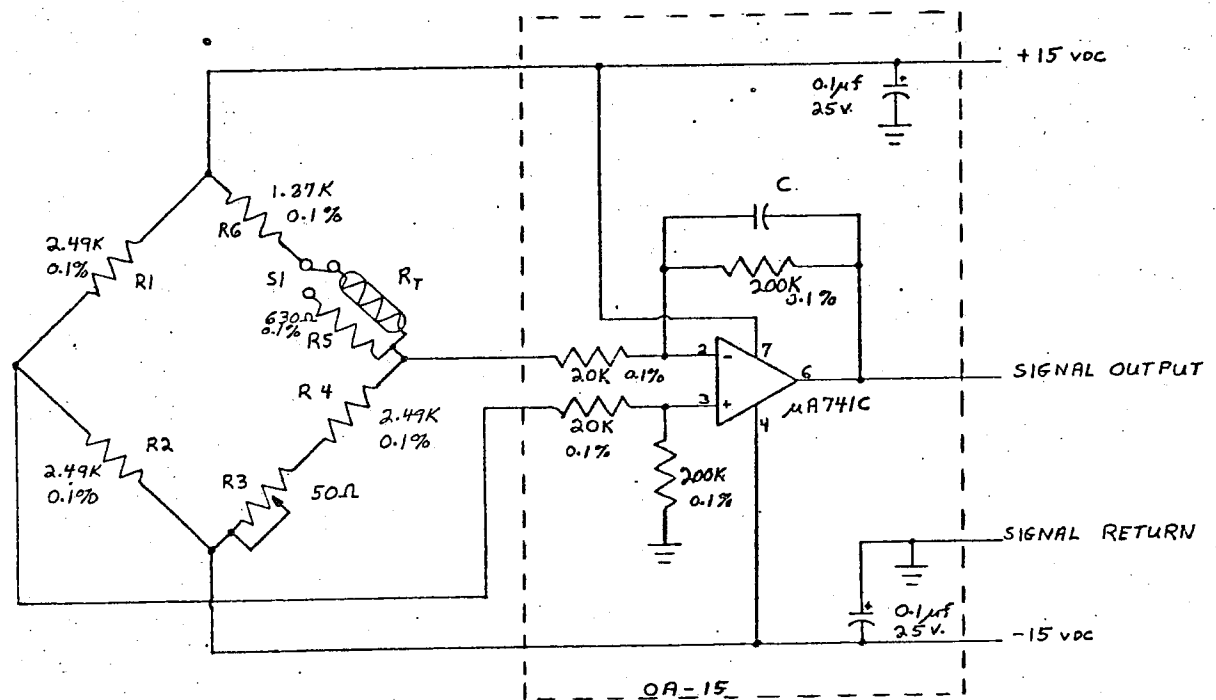
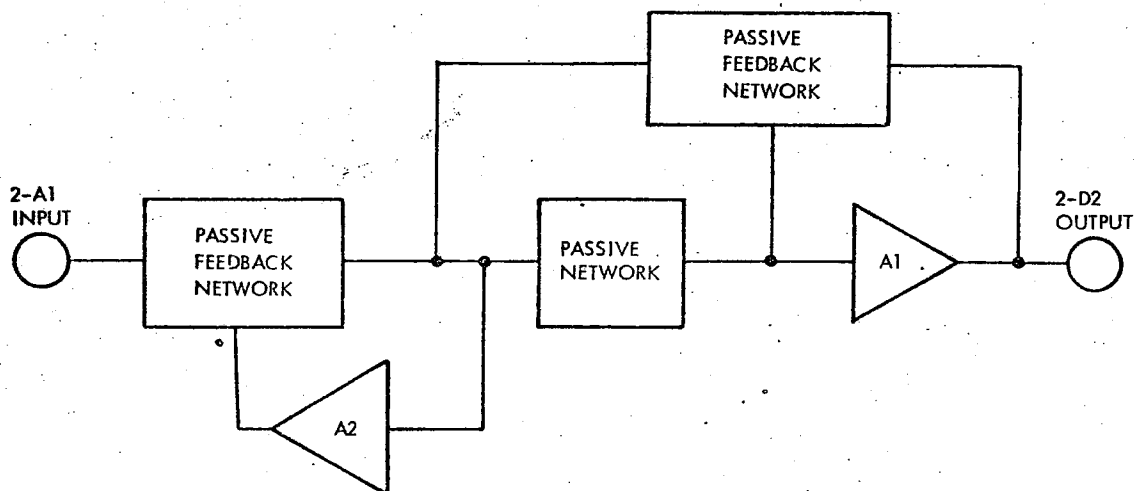


Figure 2-2 Temperature Sensing Amplifier

Unless the transducer impedance is swamped out in the bridge configuration, the output will be nonlinear by as much as 10 to 15 percent. By including the 1.87 K resistor in series with the sensing resistance, the nonlinearity is reduced to less than 5 percent. This also reduces the bridge sensitivity to ± 0.5 volts, which is a good tradeoff between linearity and noise level. The nonlinearity is washed out in the calibration tables, and as a result the end-to-end accuracy should be better



DESCRIPTION

The two-pole active low pass filters provide an inverting unity gain with the pole location fixed at one of two frequencies (2 different, 2X modules). The Butterworth characteristic (with $\xi = 0.707$) is provided. The damping ratio is adjustable to vary the output phase characteristic.

SPECIFICATIONS

Gain	-1.0 fixed $\geq 0.2\%$
Poles	2 modules, 60 Hz, DA-10; 1600 Hz, DA-11; +25% -0%
Damping Ratio ξ	Adjustable, 0.9 to 0.4, +0.1, -0.05
Filter Characteristics	Butterworth, $\xi = 0.707$
Offset Voltage	40 mV
Output	± 10 volt (5 mA @ 2000 ohm load)
Temperature	0° C to 75° C
Phase Shift with Temp.	0.02° / °C (max) 0.009° / °C (typ.)
Gain Drift	0.01% / °C
Maximum Level Input	± 10 V ± 7 V with minimum ξ
Short Circuit	Protected
Input Impedance	Requires less than 1000 ohm source
Pole Shift with Temp.	0.01 / °C (max)
Size	2X module

Figure 2-3 Two-Pole Active Low Pass Filter

APPENDIX C
MANUALS FOR LIM
DATA ACQUISITION SYSTEM

1. Ampex - Technical Manual for TM-16 Tape Transport
2. Ampex - Technical Manual for TM-16200 Data Electronics
3. Remex - Technical Manual Tape Spooler RS032ARC
4. Franklin Electronics - Instruction Manual TM508 High Speed Printer 3220A-32-2C32
5. Century Electronics & Instruments - Operation and Maintenance Manual for 538V DC Amplifier
6. Century Electronics & Instruments - Manual for 530C Amplifier System
7. Century Electronics & Instruments - Operation and Maintenance Manual for Model 470 Oscilloscope
8. Wavetek - Instruction Manual Model PM-720 Portable Phase Meter
9. Remex - Technical Manual Unidirectional Tape Reader RR0302RB/226/S207
10. Data Disc Inc. - F Series Disc Memory Electronics Manual
11. Data Disc Inc. - F Series Disc Memory Input/Output Manual
12. Teledyne Telemetry - Operating Instructions and Maintenance Manual for UHF/FM Transmitter TR1410 (1495.5 MHz)
13. Teledyne Telemetry - Operating Instructions and Maintenance Manual for UHF/FM Transmitter TR410 (408.6 MHz)
14. DCS - Instruction Manual for PCM System 4001
15. DCS - Instruction Manual for Modular Housing Assembly GMA
16. DCS - Instruction Manual for VCO, GOV-3.
17. DCS - Instruction Manual for FM Demodulator GFD-14.
18. DCS - Instruction Manual for Line Driving Amplifier GSA-5
19. Astro Communications Laboratory (ACL) - Instruction Manual UHF/UHF Telemetry Receiver TR104A
20. ACL - Instruction Manual Tuning Head TH-103P, 370 to 480 MHz
21. ACL - Instruction Manual Tuning Head TH-105BP, 1435 to 1535 MHz
22. ACL - Manual for Bandpass Amplifiers and Demodulators 500Kc
23. ACL - Manual for Bandpass Amplifiers and Demodulators 300Kc
24. Darcy - Technical Manual Operations & Maintenance Digital Multimeter DM330 and DD330

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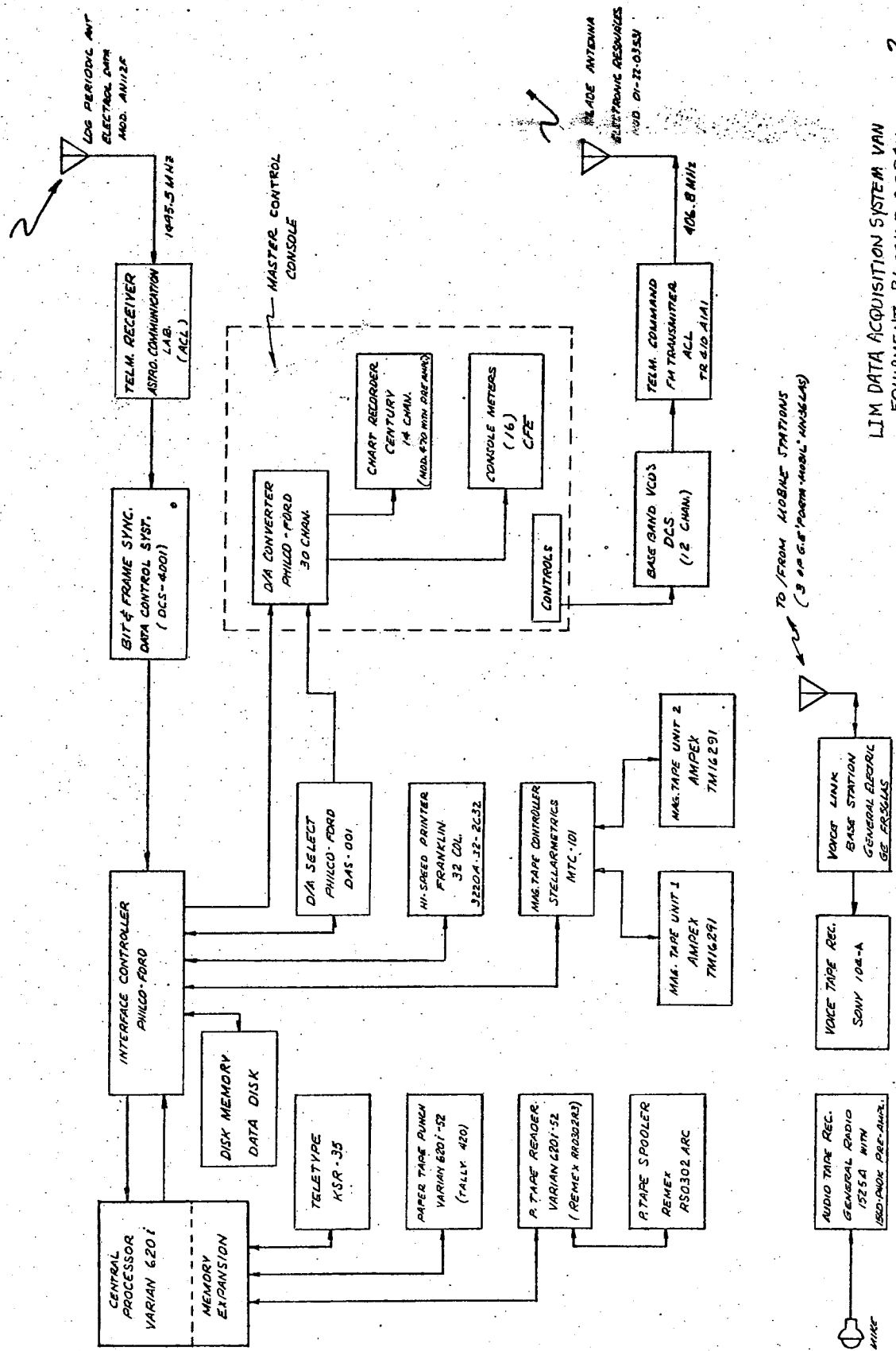
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INSTRUCTION MANUAL

FOR

LIM DATA ACQUISITION SYSTEM, v. 2.

VOLUME II OF II

PHILCO-FORD Corporation
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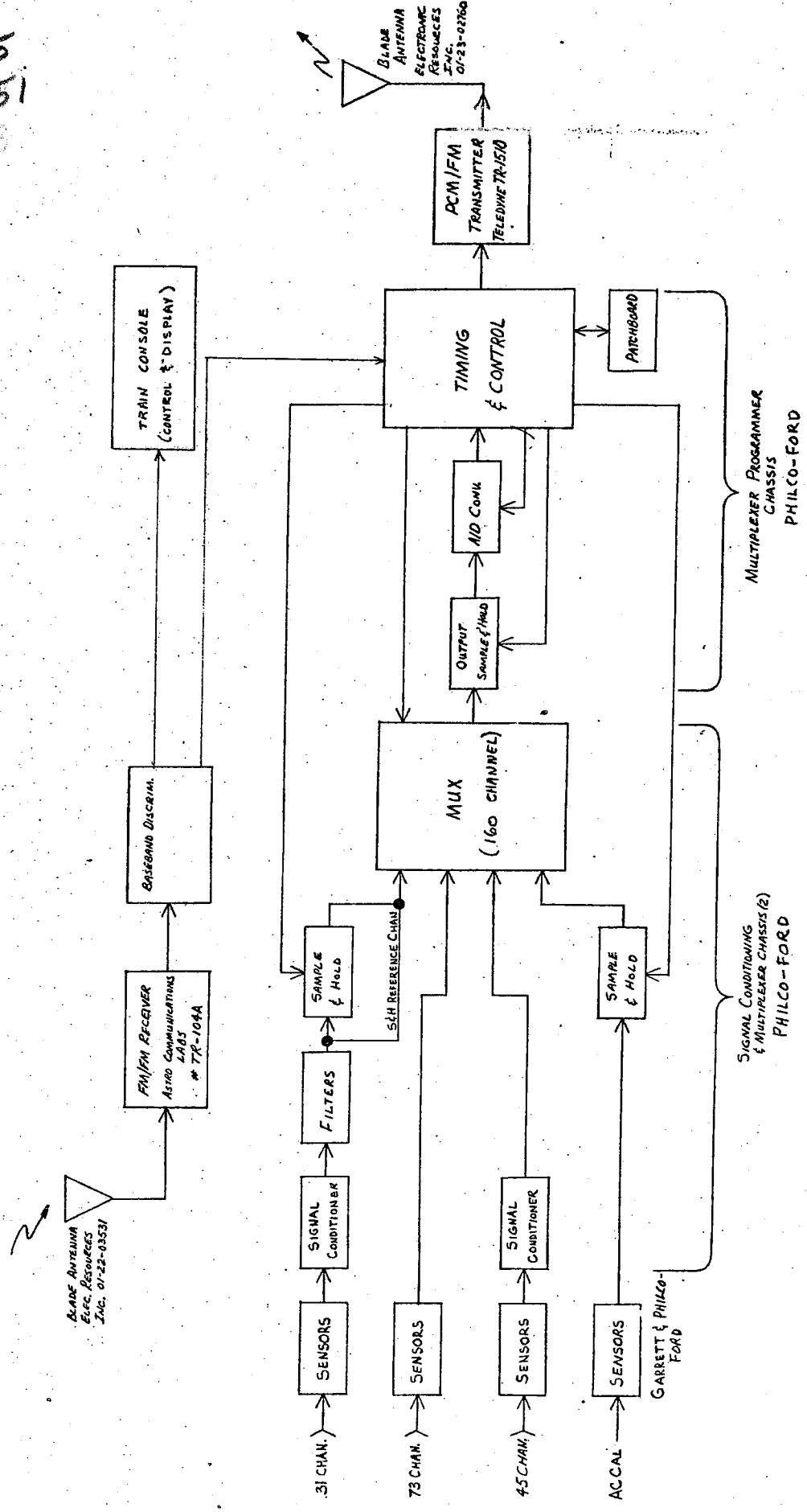


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LIM DATA ACQUISITION SYSTEM TRAIN
EQUIPMENT, BLOCK DIAGRAM



BLADE ANTENNA
ELEC. RESOURCES
INC. 01-22-03531

FM/PM RECEIVER
Astro Communications
TR-104A

TRAIN CONSOLE
(CONTROL & DISPLAY)

BASEBAND DISCRIM.

PCM/FM
TRANSMITTER
TELETYPE TR-150

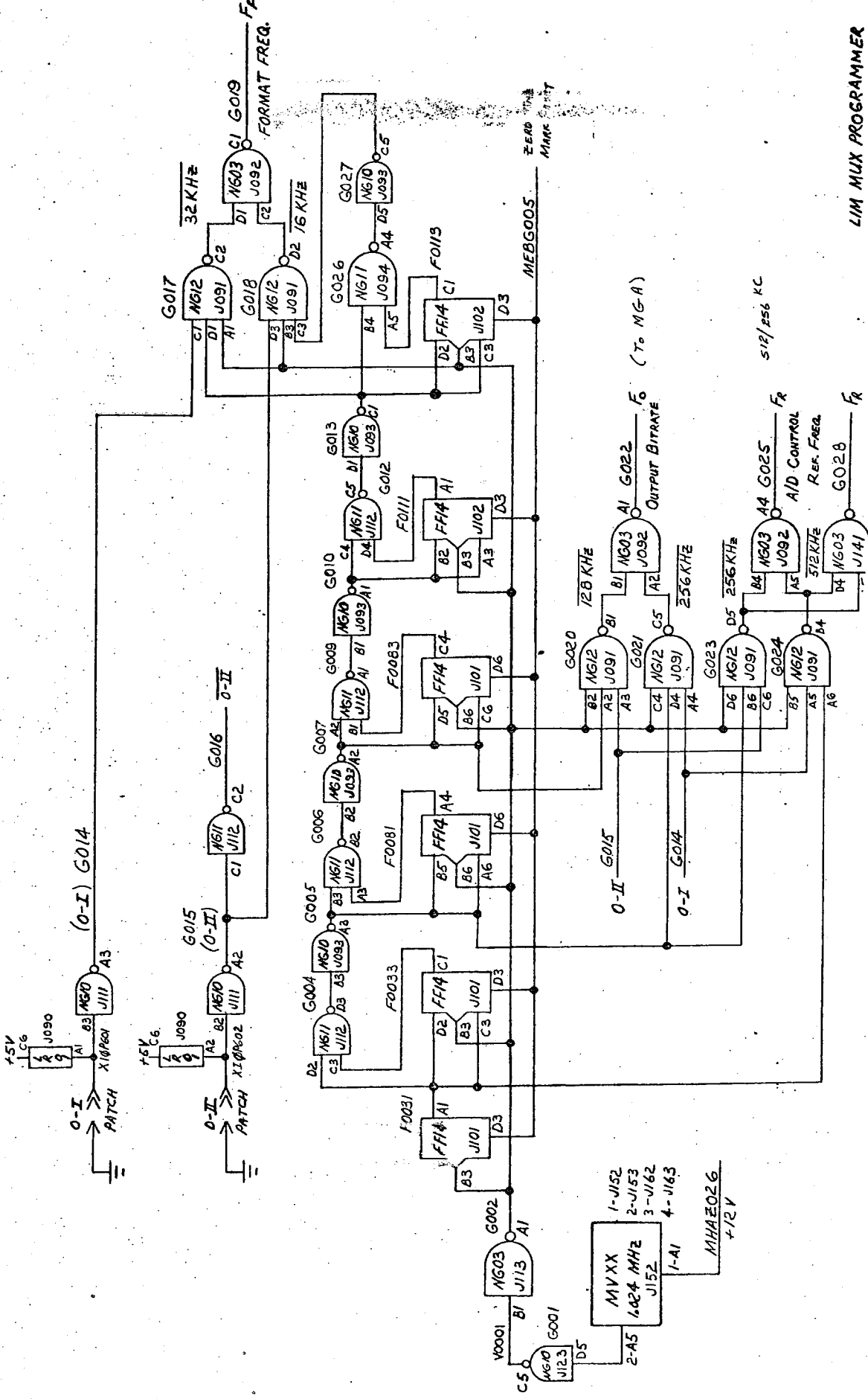
MUX
(160 CHANNEL)

TIMING
& CONTROL

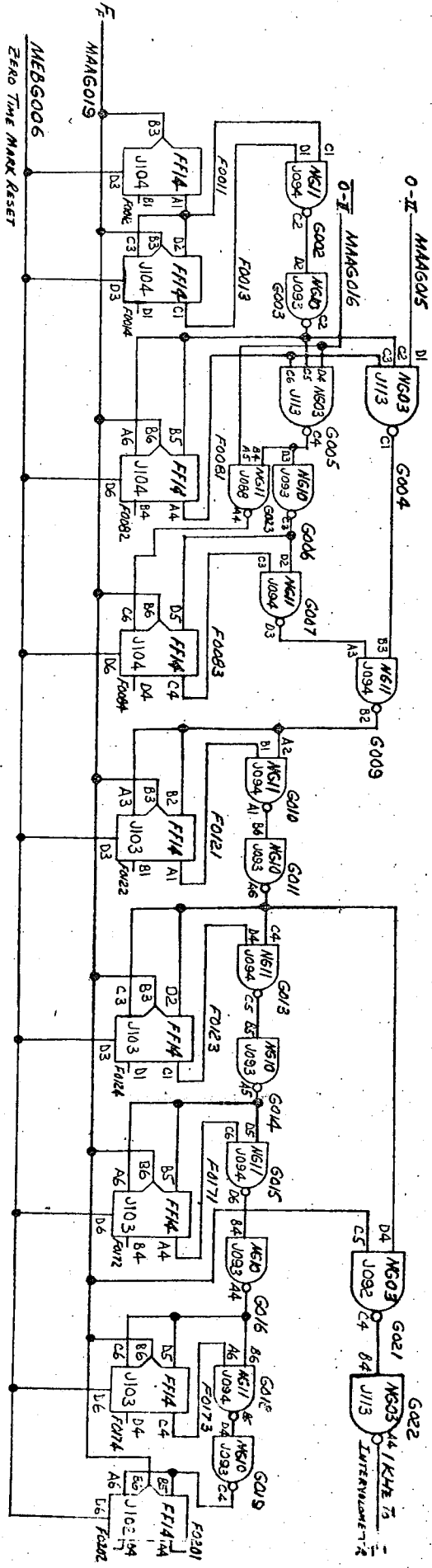
MULTIPLEXER PROGRAMMER
CHASSIS
PHILCO-FORD

SIGNAL CONDITIONING
& MULTIPLEXER CHASSIS (2)
PHILCO-FORD

GARRETT & PHILCO-
FORD



LIM MIX PROGRAMMER
 FUNCTIONAL CLASS MAA
 CLOCK GENERATOR



LIM MIX PROGRAMMER
 FUNCTIONAL CLASS MAB
 FORMAT COWITZK