No. 0-2368 Date May 28, 1969

FINAL REPORT

TELEMETRY MODULATION SYSTEM MSC-TS-8A

January 9, 1968

PREPARED FOR

NASA MANNED SPACECRAFT CENTER

R & D PROCUREMENT BRANCH

Houston, Texas 77058

CONTRACT NO. NAS 9-7741

Norden DIVISION OF UNITED AIRCRAFT CORPORATION

PUBLICATIONS

PUBLICATIONS DEPT.

THROGGS NECK, NEW

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

FINAL REPORT

TELEMETRY MODULATION SYSTEM

I INTRODUCTION

The MMS-37 High Reliability Telemetry Modulation System is supplied to NASA Manned Spacecraft Center under NASA Contract No. NAS9-7741 in accordance with NASA Specification No. MSC-TS-8A, dated January 9, 1968. The system is a hybrid microminiature FM Multiplex consisting of six Vector Model MMO-33 Microminiature High Level Voltage Controlled Oscillators, two Vector Model MMA-30 Microminiature Composite Signal Amplifiers, one Vector Model MMF-30 Microminiature Audio Filter, one Vector Model MMR-10 Microminiature Reference Oscillator, isolation transformers, and two pre-emphasis networks assembled and housed in a milled aluminum case.

II FUNCTION

The system was designed to be used aboard manned spacecraft, to monitor six analog data functions together with a voice communications channel. Analog data from six external sensors is applied to each MMO-33 Voltage Controlled Oscillator, where it is converted into an FM signal band. These six FM signals are resistively summed with the outputs of the MMF-30 Audio Filter and the MMR-10 Reference Oscillator to form an FM multiplex composite signal which is conditioned for recording and simultaneous rf transmission by two separate pre-emphasis networks before being applied to each MMA-30 Composite Signal Output Amplifier.

III ILLUSTRATIONS, DRAWINGS, AND PHYSICAL DESCRIPTION

Drawing 80001354 presents the electrical schematic of the Telemetry Modulation System.

Drawing 82000230 shows the outline and detail external mounting dimensions, and connector locations of the system which is housed in a hermetically sealed case 5.5 inches by 2.5 inches by 2.0 inches. The case has a matte gold plating and contains an ITT Cannon type DBH-25P-001-A158, 25 pin input/output connector.

Photographs have been included to provide a visual reference. Figure 1 exhibits an assembled system with its cover and seal removed together with representative plug-in components - an MMF-30 Audio Filter, an MMR-10 Reference Oscillator and an MMO-33 VCO. Figure 2 depicts an internal bottom view of the disassembled component mount. Displayed are the connector wiring and wiring harness to the internal interconnect. Also shown is the printed circuit board which provides a bottom cover plus the mounting surface for the isolation transformers (8) and the pre-emphasis resistors (which are not visible). In addition, various plug-in components are shown.

IV SUMMARY OF CONTRACT EFFORT

Initially, after the award of this contract (end of March 1968), detailed performance specifications were generated for each active hybrid microcircuit device type. The design of these devices is based on the standard Vector micro circuit product line. Replacement of a single system power supply by individual supplies was required for each VCO, Composite Signal Amplifier and Audio Filter to enhance reliability and prevent a single point failure mode from disrupting the entire system. DC to DC Converters were necessitated by the ground isolation requirements of the specification. Signal isolation was also provided by inclusion of transformers on the internal component mount.

Each of the discrete electrical and mechanical elements utilized within the systems was selected to be of the best available quality and reliability.

Before system integration, each active device was extensively performance tested and run to assure compliance of the performance specification requirements and basic device stability and reliability.

The first system assembled was also extensively tested to assure conformance and then successfully subjected to an extensive qualification test program simulating both extreme earth and space environments.

V CONCLUSIONS AND RECOMMENDATIONS

In the final analysis, probably the largest in-process problem was the definition, location, procurement and delivery of the small quantities of high reliability components required. Extensive effort was expended together with the help of the cognizant NASA personnel in achieving this task.

From a systems standpoint, only two recommendations can be made which may improve the combined performance and reliability of the system. First, the elimination of the potentiometer output adjustment would eliminate possibly the least reliable component. Secondly, if it were possible, considering the overall system operational requirements, the elimination of the grounding specifications requiring the employment of DC to DC converters would serve to decrease both the system size and significantly reduce the RFI interference noise generated while increasing the system performance reliability.

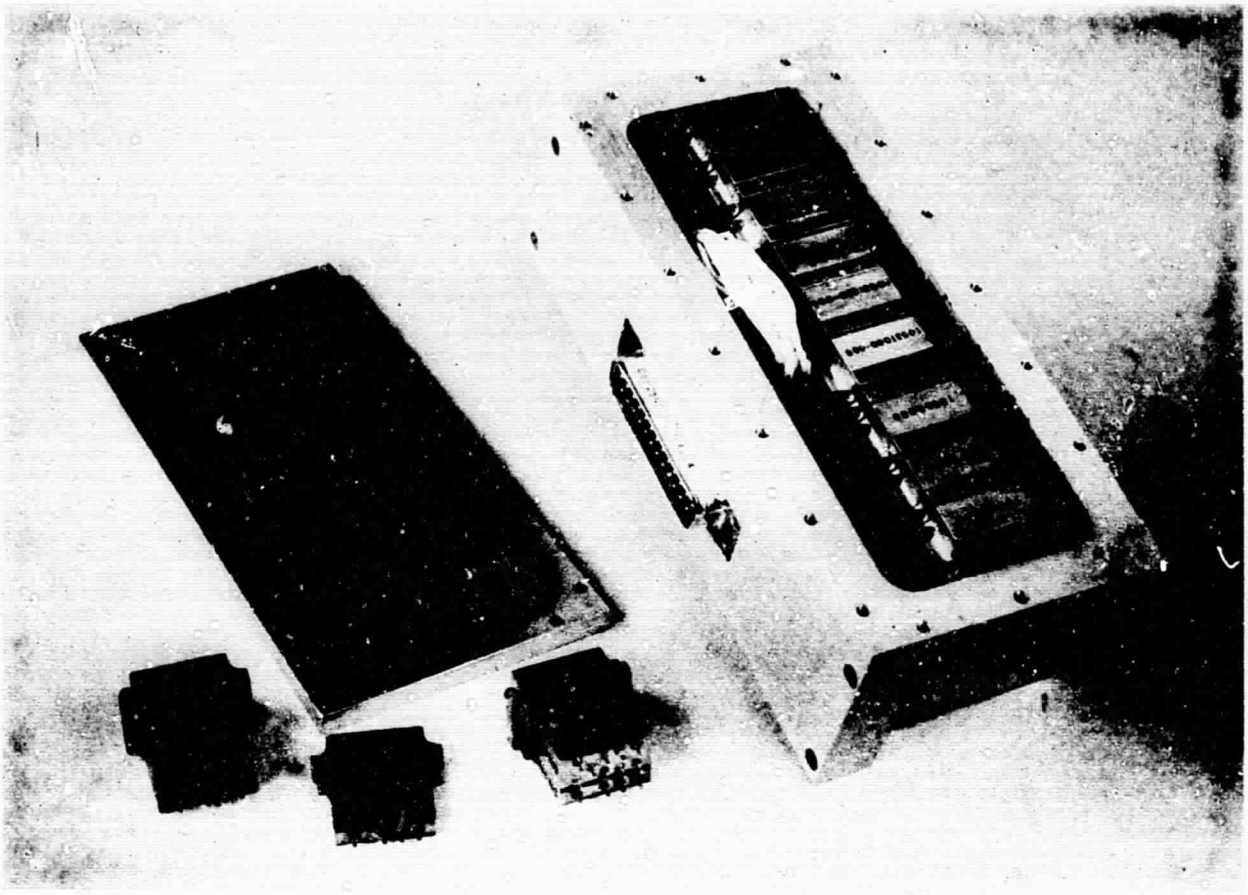


Figure 1.

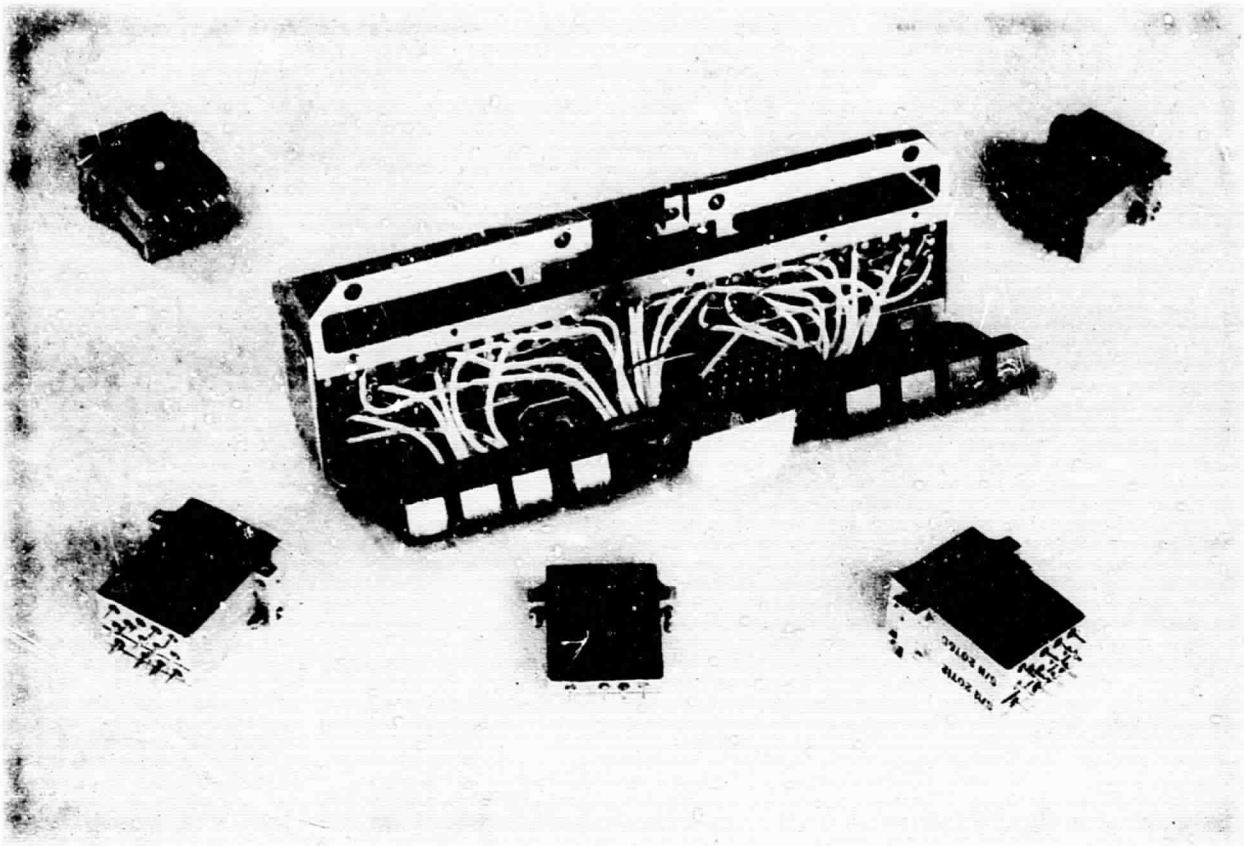
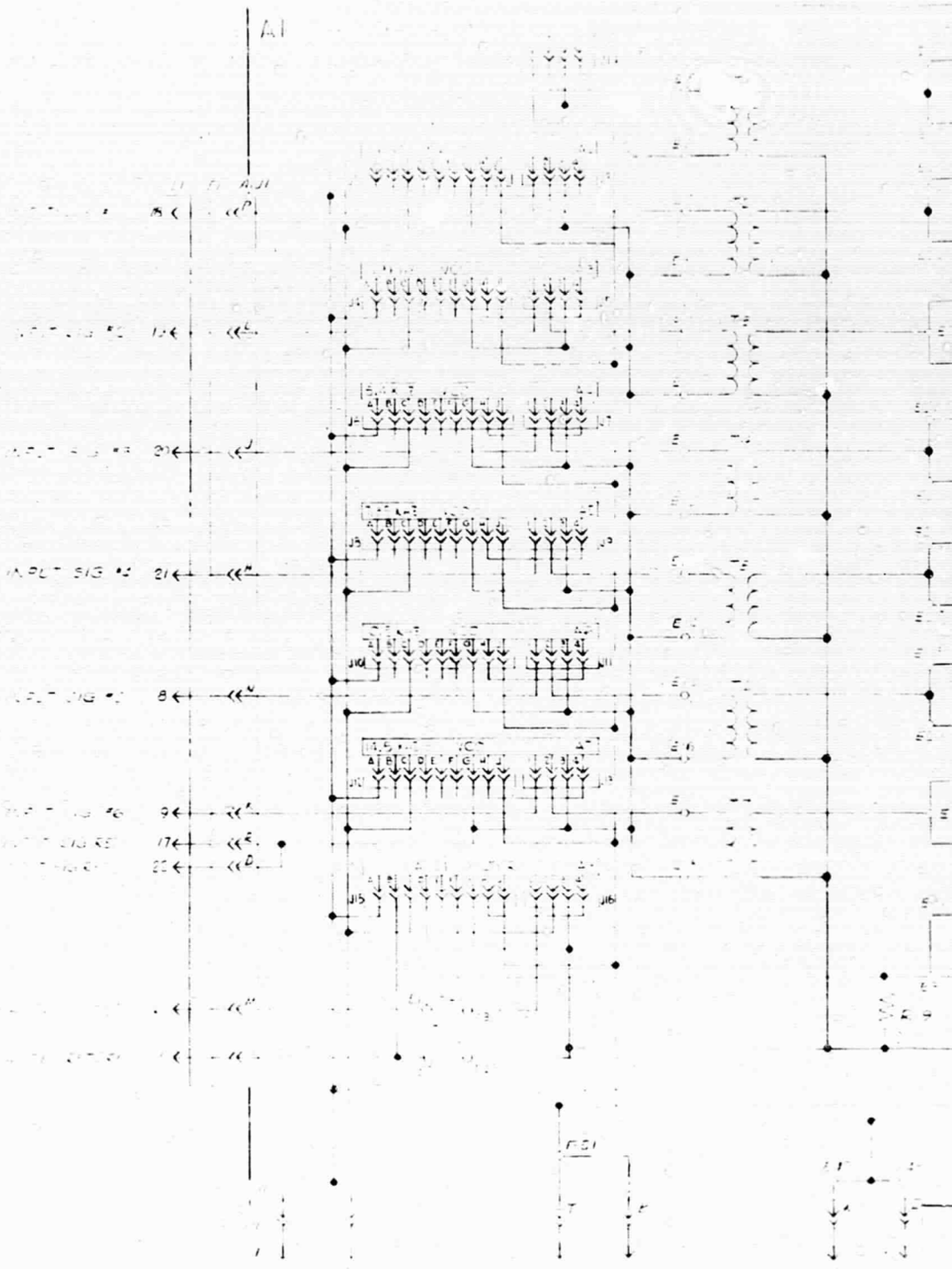


Figure 2.

Foldout #1

NOTES

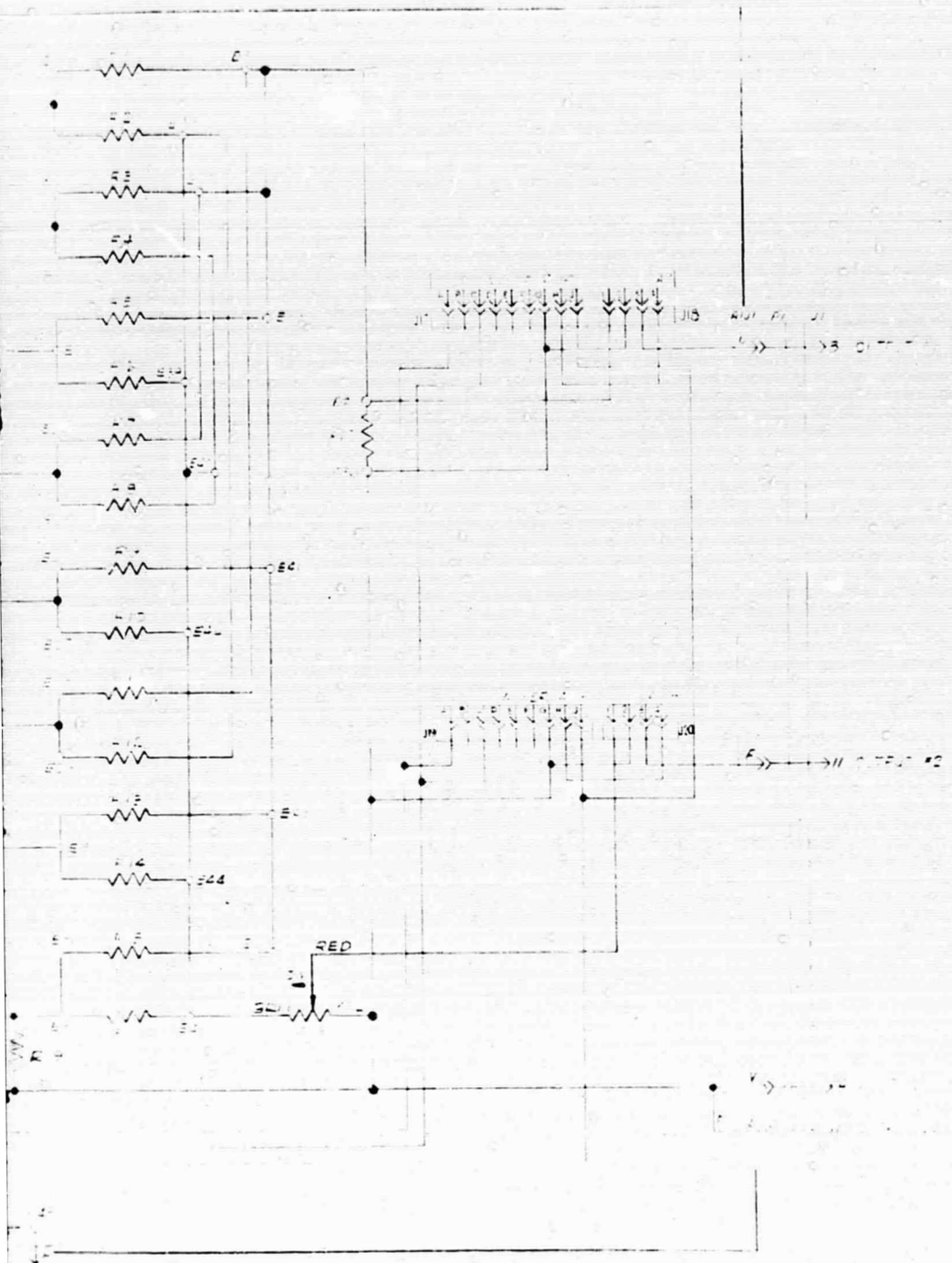
1. INTERPRET THIS DRAWING IN ACCORDANCE WITH STANDARDS PRESCRIBED BY MIL D 1000



Foldout #2

4	3	2	1

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
		PRODUCTION RELEASE. DRN.		



DASH NO.	NEXT ASSY	USED ON
	APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ON: FRACTIONS ± DECIMALS ± ANGLES ±

MATERIAL:

FINISH:

CONTRACT NO.	
CUST.	
CPD. NORDEN	
APPROVAL	DATE
DRAWN	
CHECKED	
MECH. ENG.	
ELECT. ENG.	
Q.A. REL.	
PROJ. ENG.	

Norden COMMUNICATIONS PRODUCTS DEPT. UA

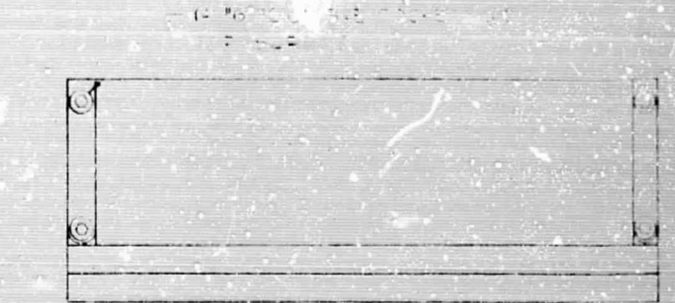
SIZE	CODE IDENT NO.	DRAWING NO.
D	13923	

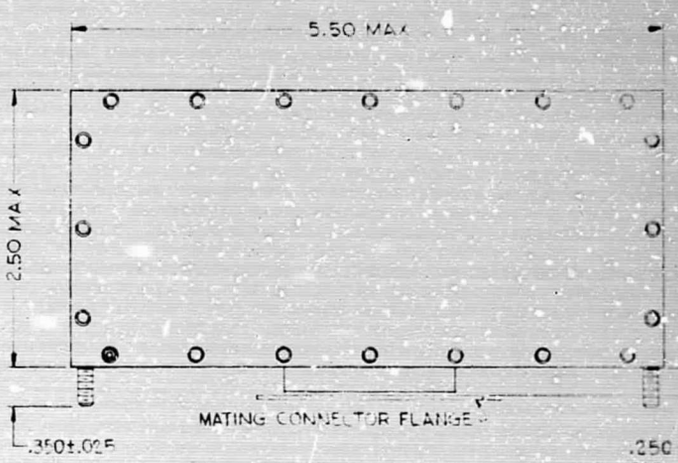
SCALE | SHEET

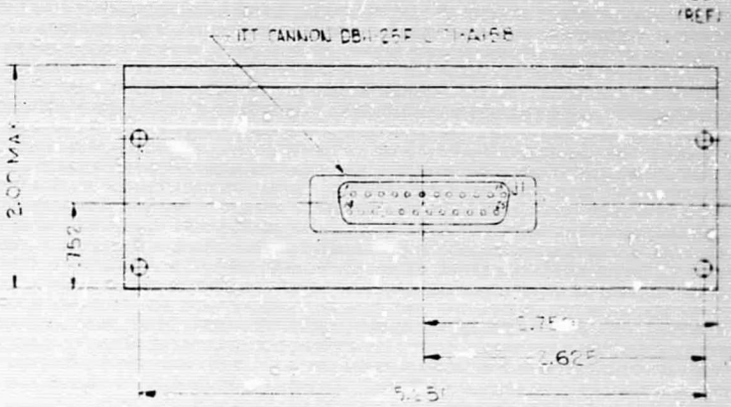
Foldout #1

NOTES

1. INTERPRET THIS DRAWING IN ACCORDANCE WITH STANDARDS PRESCRIBED BY MIL-D-1000.
2. T[illegible] FLAG RECEPT[illegible] MOUNTING SCREWS REQUIRE A LOCKING FEATURE.
3. B[illegible] SHALL BE FINISHED TO .0005 THK MATTE GOLD PLATE PER MIL-G-45204A, CLASS 1, OVER .0005" ELECTROLESS NICKEL PER MIL-C-26074A.







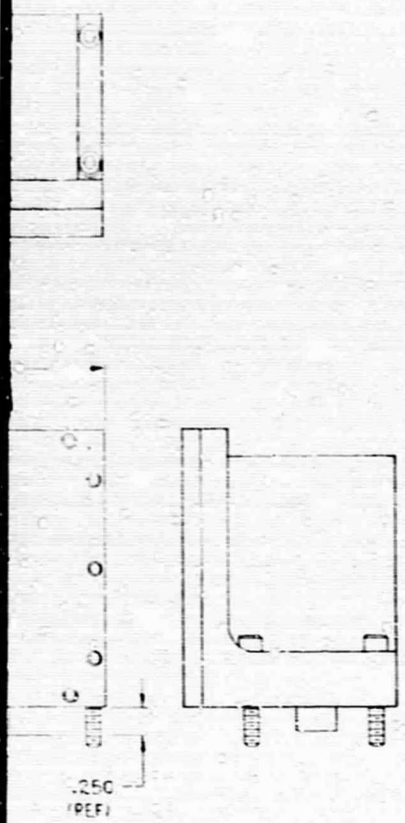
J1 PIN FUNCTIONS	
PIN	FUNCTION
1	+28 VDC INPUT
2	SPARE
3	OUTPUT SIG #1
4	OUTPUT SIG #1 RETURN
5	AUDIO RETURN
6	AUDIO INPUT
7	SPARE
8	SIGNAL INPUT #1
9	SIGNAL INPUT #2
10	OUTPUT SIG #2 RETURN
11	OUTPUT SIG #2
12	SPARE
13	+28 VDC INPUT
14	SPARE
15	SPARE
16	SPARE
17	INPUT SIG #1 RETURN
	SPARE
	SPARE
	SPARE
	SPARE
	SPARE
	SPARE
	SPARE
	SPARE

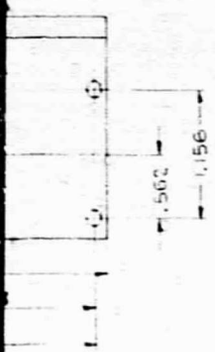
			UNLESS OTHE DIMENSIONS TOLER
			FRACTIONS ±
			MATERIAL
	PL222[illegible]	MIMS-37	FINISH
DASH NO.	NEXT ASSY	USED ON	
	APPLICATION		

FORM 370-7A K+E

Foldout #2

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	—	FILE RELEASE. DRN-		
B2	A	INVERTED J1		
		PRODUCTION RELEASE. DRN-		





8200230

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ON: FRACTIONS ± [illegible] DECIMALS ±.010 ANGLES ± [illegible]	CONTRACT NO.	Norden COMMUNICATIONS PRODUCTS DEPT. U A.	
	CUST N383 77-1		
	CPD NORDEN		
	APPROVAL / DATE: DRAWN [illegible] [illegible]; CHECKED [illegible] [illegible]; MECH ENG [illegible] [illegible]; ELECT ENG [illegible] 7/11/82; QA-REL	OUTLINE TELEVISION MONITOR	
MATERIAL:	PROJ ENG [illegible] 7/12	SIZE C	CODE IDENT NO. 13923
FINISH:		SCALE 1/1	DRAWING NO. 8200230 [illegible] SHEET [illegible]