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MACROMODULAR
COMPUTER DESIGN
PART 2
MANUFACTURING DESCRIPTION

VOLUME XI

CABLES

Technical Report No. 40

FINAL REPORT - FEBRUARY, 1974

CONTRACT SD-302 (ARPA)

COMPUTER SYSTEMS LABORATORY

WASHINGTON UNIVERSITY

ST. LOUIS, MISSOURI

MACROMODULAR COMPUTER DESIGN
FINAL REPORT - CONTRACT SD-302
FEBRUARY, 1974

Technical Report No. 40

PART 2 - MANUFACTURING DESCRIPTION
VOL. XI-CABLES

This work has been supported by the Advanced Research Projects Agency of the Department of Defense under Contract SD-302 and by the Division of Research Facilities and Resources of the National Institutes of Health under Grant RR-00396.

The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the Advanced Research Projects Agency or the U.S. Government.

Computer Systems Laboratory
Washington University
St. Louis, Missouri

ABSTRACT

Manufacturing information for the construction and testing of macromodular cables is given. Included are the DATA CABLE, CONTROL CABLE, PEDESTAL DAISY CHAIN CABLE, and FUNCTION CALLER CABLE.

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360

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360-11	MODIFIED STRIP TOOL	

[illegible]

[illegible][illegible]

360-2

ASSEMBLY SPECIFICATION
MACROMODULAR CONTROL CABLE

September 11, 1968

Revised December 28, 1970

Introduction:

This specification describes a cable and connector assembly which will carry high-speed digital control signals in a restructurable computer system. The cable assemblies are to be manufactured from lengths of a special 120 ohm twisted pair shielded cable with an AMP connector on each end.

Cable:

The cable was manufactured by the Brand Rex Division of the American Enka Co. Complete details of the cable construction may be found in Macromodular Project Specification CAS-4 and CAS-7 in Document 010. New cables are to be made from CAS-7 material.

Connector:

Each end of the cable is terminated by a single AMP twin Standard Coaxicon Connector. The connector consists of an AMP 329054 plug and an AMP 329056 shield ferrule.

Wire Preparation:

The length of a completed cable assembly is defined by dimension L on drawing 360-7. The actual wire length is about 7/8 inches shorter than the completed assembly. Table 1, in a later section, defines the assembly and cable lengths to be manufactured.

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A	0245	1-11-72	

Cut the cable to proper length and slip a 329056 ferrule, small end first, onto the cable. Strip the outer PVC jacket back one inch, taking care not to nick or break any of the shield wires. The braided shield provides both a ground connection and mechanical support to the cable.

The cable jacket may be stripped with a tool such as the one shown on 360-11. This is a standard Hunter strip tool which has been modified for a circular aperture of 0.110 inches. This primary stripping operation may not be done with a knife.

The braided shield is to be combed out and formed into two equal pigtails (Dwg. 360-8) and pushed back over the unstripped portion of the cable. Do not twist the pigtails, simply group the individual wire strands into two bundles. The two internal conductors are then cut to a length of .438 inches and stripped back 1/4 inch. Stripping dimensions for jacket and inner conductors are shown on drawing 360-7.

The cable must be constrained during the stripping process as the internal components will easily slip out of the outer jacket; a vise with plastic jaws is suggested (Pana-Vise). Techniques of wire stripping must be disclosed prior to manufacture, and the method is subject to final approval by the Computer Systems Laboratory.

Crimping:

The crimp die is AMP 69231-2 which may be used in hand tools 45707-2 or 69710. The die may also be used in AMP production tools 69365 or 69365-2.

Insert yellow wire into hole I of 329054 plug, and clear wire into hole II. Hole I has the small oval crimping port, and hole II has the large crimping port. Refer to drawing 360-7 for illustration of plug polarity.

Pull shield pigtails over rear of plug, and seat ferrule in place over shield. Orient pigtails as shown on Dwg. 360-8 in order to avoid interference with the crimp dies.

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Insert connector, wire, and ferrule into crimp tool. Close crimp tool slowly while observing seating of wire-barrel crimping dies. These dies must be aligned with the oval ports of the 320954 plug. When alignment is assured, close tool until dies bottom; then open and remove completed connector.

The connector assembly must be supported during the crimping procedure to prevent the wires or shield from slipping away from the plug. Any shield wire which protrudes from the ferrule after crimping shall be trimmed away. The final plug must have a smooth feel.

A secondary crimp operation is now performed to capture the cable jacket. CSL will supply a crimp die (Dwg. 360-9) suitable for mounting in an arbor press.

Place the crimped connector and cable assembly into the die as shown on page 360-10. Operate the arbor press until the dies bottom out. Then open the die and remove the completed cable end.

Lengths:

The cable assemblies shall be manufactured in the following lengths:

ASSEMBLY LENGTH	CABLE LENGTH
4 Inches	3-1/8 Inches
5 "	4-1/8 "
6 "	5-1/8 "
7 "	6-1/8 "
8 "	7-1/8 "
9 "	8-1/8 "
12 "	11-1/8 "
18 "	17-1/8 "
24 "	23-1/8 "
36 "	35-1/8 "

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ASSEMBLY LENGTH

CABLE LENGTH

48 Inches	47-1/8 Inches
60 "	59-1/8 "
120 "	119-1/8 "

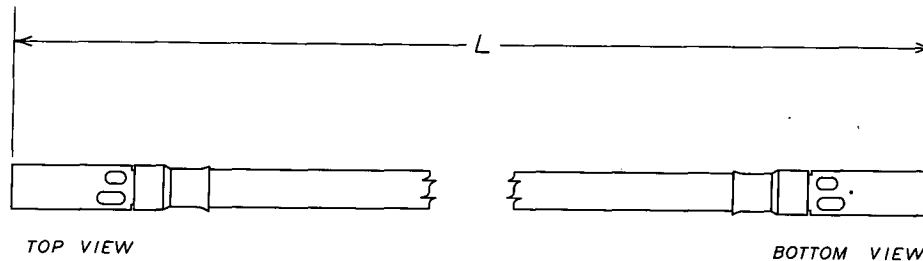
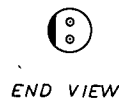
Inspection:

The completed cable assemblies shall be tested for end-to-end continuity and leakage to the shield. The end-to-end resistance shall be less than 0.5 ohm per foot of cable for each of the two conductors and the shield. The leakage resistance between either inner conductor and the other conductor or shield shall be greater than one megohm.

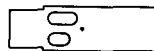
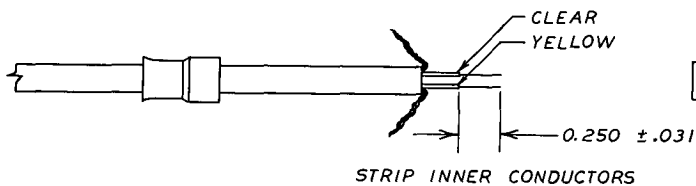
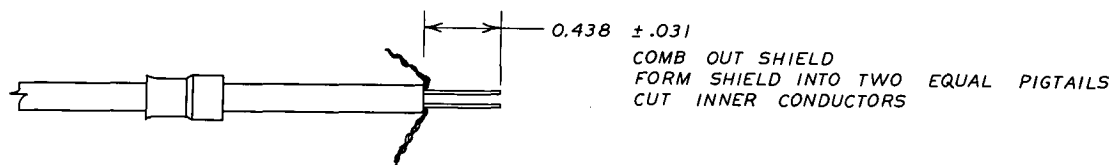
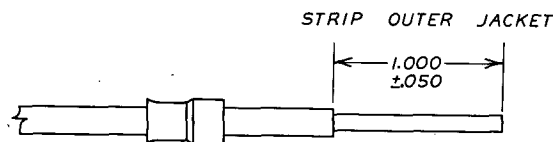
Quality:

The completed cables shall reflect the workmanship standards of the best commercial practice.

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STRIPPING DIMENSIONS



POLARITY

YELLOW - HOLE I - SMALL PORT (LOGIC HIGH)
CLEAR - HOLE II - LARGE PORT (LOGIC LOW)

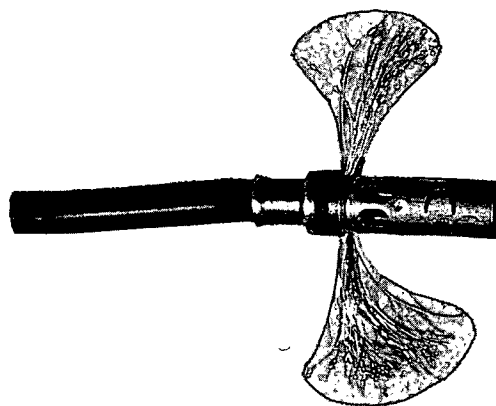
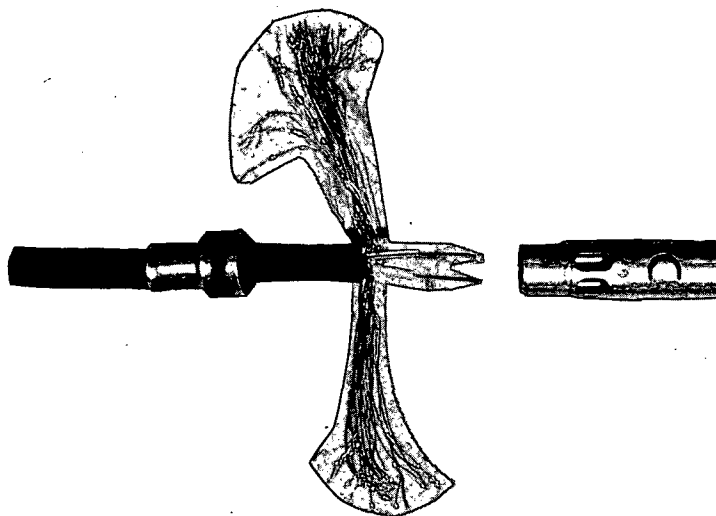
CONNECTOR

AMP TWIN STANDARD COAXICON
PLUG: AMP 329054
FERRULE: AMP 329056

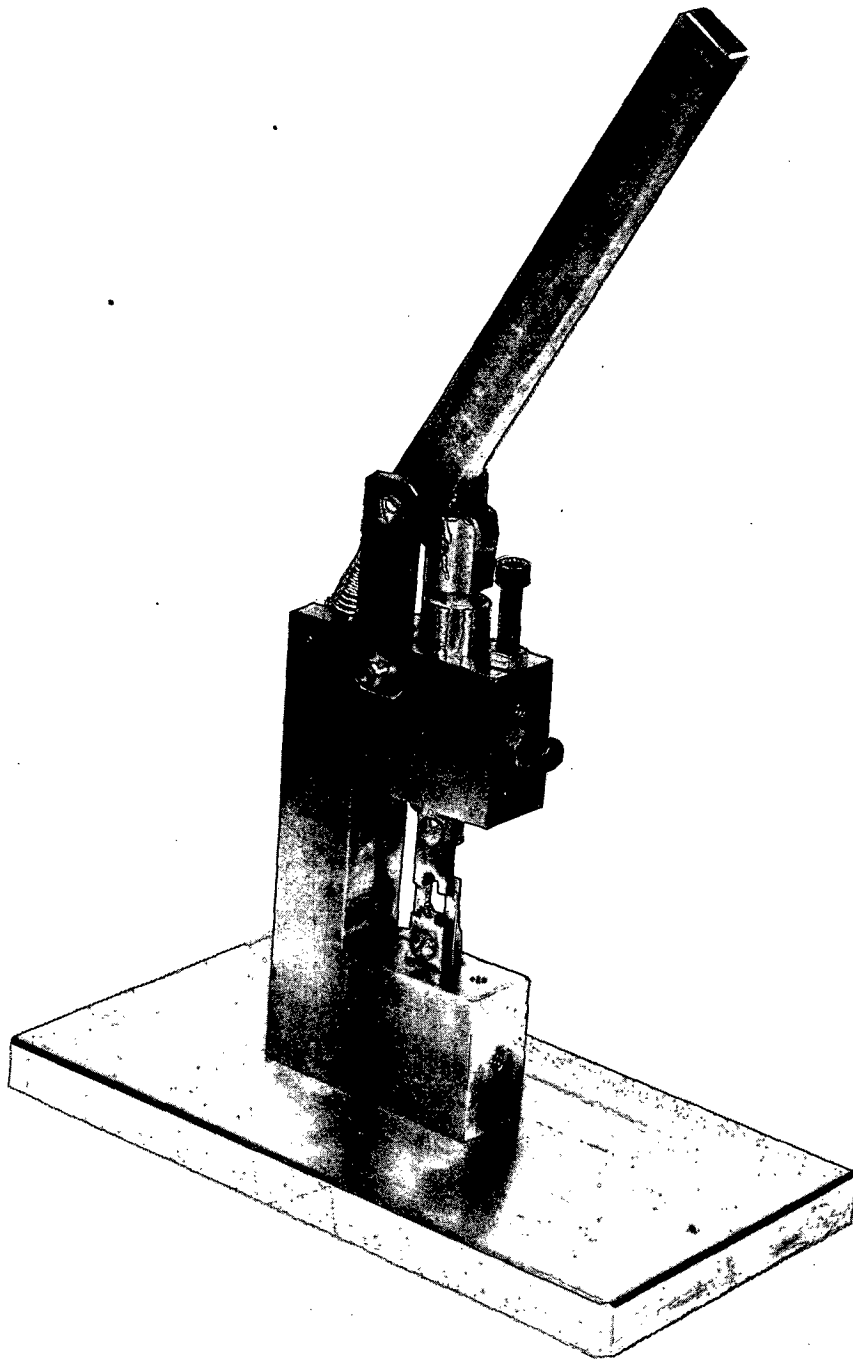
CABLE

SPECIFICATION CAS-4 120 OHM CABLE

ISSUE 1-7-71		GCJ	
CHANGE NO.	DATE	DESCRIPTION	
COMPUTER SYSTEMS LABORATORY WASHINGTON UNIVERSITY ST. LOUIS, MISSOURI			
MACROMODULAR PROJECT			
TITLE CONTROL CABLE ASSEMBLY STRIPPING - POLARITY			
BY	APPROVED	ENG.	DRAWING NO.
GCJ	FOR	GCJ	360-7
PROD	DATE	DRAWN BY	
	12-30-70	PLL	
CHECKED	DATE		
GCJ	12-29-70		



COMPUTER SYSTEMS LABORATORY WASHINGTON UNIVERSITY ST. LOUIS, MISSOURI			MACROMODULAR PROJECT				
			TITLE ASSEMBLY ORIENTATION				
			APPROVED BY <i>GCJ</i> FOR PROD. DATE 1-7-71			ENG GCJ	DRAWING NO. 360-8
ISSUE 1-7-71 <i>GCJ</i>						DRAWN BY DHO	
CHANGE NO.	DATE	DESCRIPTION				CHECKED GCJ	DATE 1-7-71



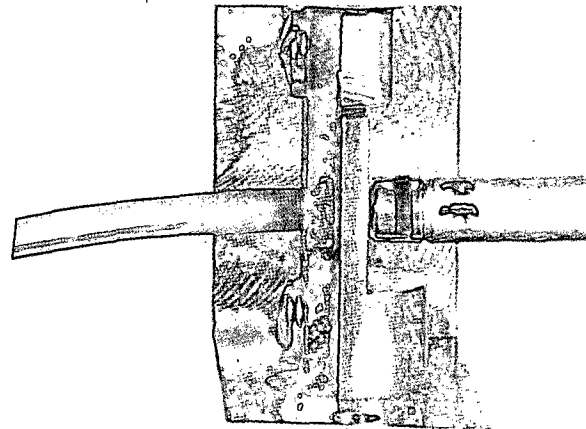
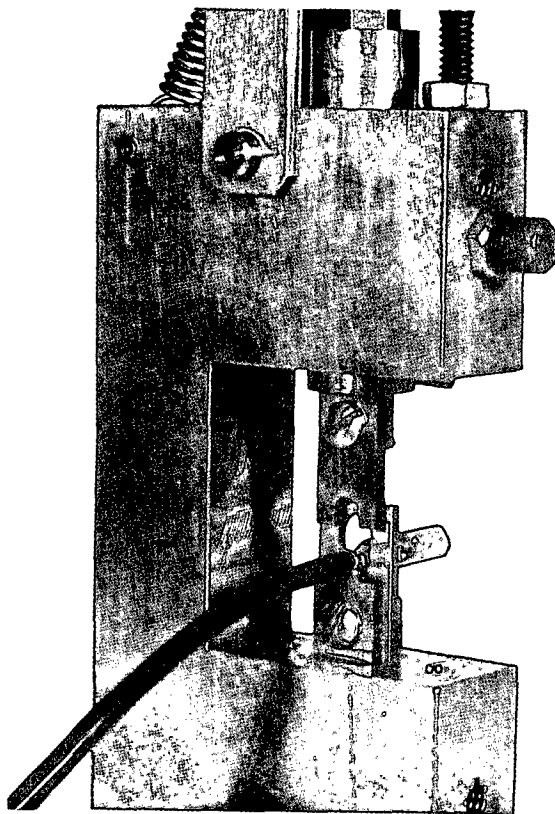
COMPUTER SYSTEMS LABORATORY
WASHINGTON UNIVERSITY
ST. LOUIS, MISSOURI

MACROMODULAR PROJECT

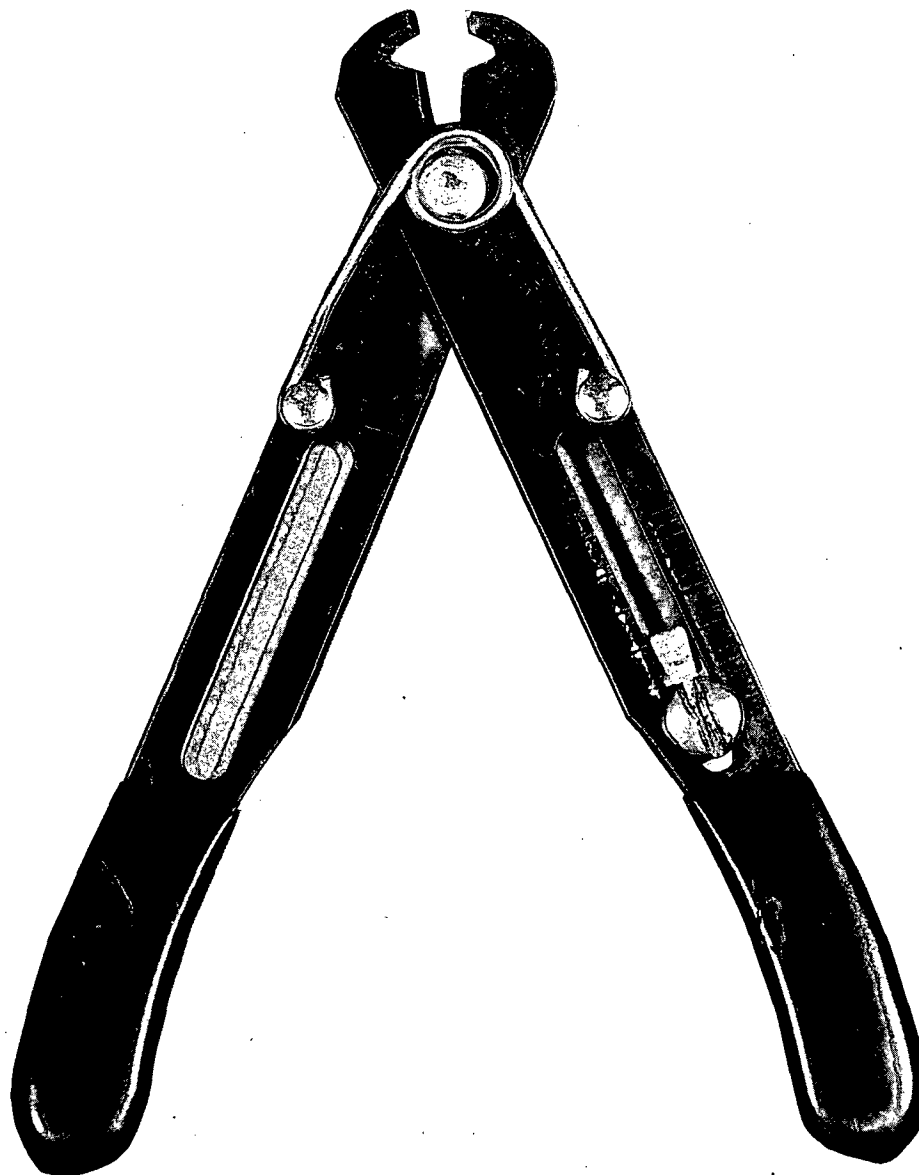
TITLE

SECONDARY CRIMP DIE

			APPROVED		ENG	DRAWING NO.	
			BY	FOR	DATE		G CJ
ISSUE 1-29-71		Def	Def	ASSBY	1-29-71	DRAWN BY	360-9
CHANGE NO.		DATE				GWP	
						CHECKED	DATE
						Def	1-29-71



		COMPUTER SYSTEMS LABORATORY WASHINGTON UNIVERSITY ST. LOUIS, MISSOURI		TITLE SECONDARY CRIMP ORIENTATION			
				APPROVED BY <i>GCJ</i> FOR <i>ASSBY</i> DATE <i>1-29-71</i>		ENG. <i>GCJ</i> DRAWN BY <i>GWP</i>	DRAWING NO. 360-10
ISSUE <i>1-29-71</i> <i>GCJ</i>		MACROMODULAR PROJECT				CHECKED <i>GCJ</i>	DATE <i>1-29-71</i>
CHANGE NO.	DATE			DESCRIPTION			



COMPUTER SYSTEMS LABORATORY WASHINGTON UNIVERSITY ST. LOUIS, MISSOURI			MACROMODULAR PROJECT		
			TITLE MODIFIED STRIP TOOL		
			APPROVED BY <i>GCJ</i> FOR PROD. DATE 1-11-71		ENG GCJ
					DRAWN BY DHO
ISSUE 1-11-71 <i>GCJ</i>					CHECKED GCJ
CHANGE NO.	DATE	DESCRIPTION			DATE 1-11-71

361

PAGE	TITLE	CHANGE
361-1	TITLE PAGE	D
361-2 thru 361-5	ASSEMBLY SPECIFICATIONS	B, C
361-6	ASSEMBLY SEQUENCE PICTORIAL	B
361-7	DAISY CHAIN CABLE HEAD	
361-8	CABLE HEAD ADAPTER	A
361-9	CABLE HEAD TINED FERRULE	D

CHG.	E.C.O.	DATE	APPR	CHG	E.C.O.	DATE	APPR	CHG.	E.C.O.	DATE	APPR.
ISSUE	—	12-7-70	SCJ								
A	0137	12-29-70	SCJ								
B	0270	10-17-72	SCJ								
C	0277	12-7-72	SCJ								
D	0304	2-5-74	SCJ								

ASSEMBLY SPECIFICATION:
PEDESTAL DAISY CHAIN CABLE

I. Introduction

This specification describes a cable and connector assembly which will carry power sequence and alarm signals between elements of a modular computer system. The Daisy Chain Cable consists of a length of multiconductor, jacketed cable terminated by identical connectors at each end.

II. Cable Stock

The jacketed cable, National number S10-1445, was produced by National Wire and Cable Corporation, 136 San Fernando Road, Los Angeles, California 90031 to the following specification:

The cable consists of 10 #24 AWG, 19 strand conductors insulated with a 0.010 inch PVC wall and a 0.003 inch nylon wall, and 2 #22 AWG, 7 strand drain wires. The 10 insulated conductors are color coded the following solid colors: black, brown, red, orange, yellow, green, blue, violet, gray, and white. Each conductor is individually shielded with aluminum/mylar tape with the aluminum on the outside. The cable is planetary cabled with the 2 drain wires approximately 90° apart in the outer layer and has an aluminum/mylar tape shield,

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with the aluminum on the inside, over all covered with a 0.035 inch wall black PVC jacket. The finished cable has a 0.290 inch nominal, 0.310 inch maximum, O. D.

III. Connectors

The connector on each of the two ends of the cable consists of an Amphenol ASTRO 348-46E10-12S1 connector, an Amphenol 348-470-14000-02 Rear Shell Assembly, and an Adapter described by CSL drawing 361-8.

IV. Variations

All cables shall be identical except in length. The length is defined as the measurement from end to end of the cable stock before stripping and termination. The tolerance on length shall be $\pm 1/2$ inch.

The cables shall be constructed in the following lengths:

1. 4 1/2 feet
2. 10 feet
3. 25 feet

V. Assembly Sequence

1. Cut cable to length as defined above.
2. Solder a piece of 22 AWG bare tinned wire to 2 Adapters per Dwg. 361-6.
3. Slide on 2 Compression Nuts, 2 Tined Ferrules, 2 Outer Housings, and 2 Adapters per Dwg. 361-6.

Do These Operations to Both Ends of Cable

4. Cut back outer jacket 1 3/4 inches.
5. Cut away the exposed aluminum/mylar tape jacket. (Do not cut the two stranded bare tinned copper leads.)

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6. Remove the exposed aluminum/mylar tape from each of the 10 insulated conductors.
7. Trim the ends of all 12 wires 1/8 inch to eliminate damage from the cable cutting operation.
8. Strip the 10 insulated individual conductor (0.188 to 0.219 inches.)
9. All wires shall be crimped with acceptable tooling as shown in the tooling chart, or equivalent automatic tooling. The settings of the tools shall be determined by a simple pull test. The wire shall break consistently at, or near the crimp after noticeable elongation. An optimum crimped termination has 70% of the tensile strength of the wire.

TOOLING CHART

MANUFACTURER	TOOL
BUCHANAN	612596 CRIMP TOOL
BUCHANAN	613381 LOCATOR

10. Insert the contacts into the connector per Amphenol's ASTRO 348 technical manual and the following wiring list:

WIRE COLOR	PIN
Bare tinned lead	1
White.	2
Gray.	3
Red.	4
Black.	5
Brown.	6
Violet.	7
Orange.	8
Yellow.	9
Blue.	10
Green.	11
Bare tinned lead.	12

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B	0270	10-17-72	<i>SCJ</i>
C	0277	12-7-72	<i>SCJ</i>

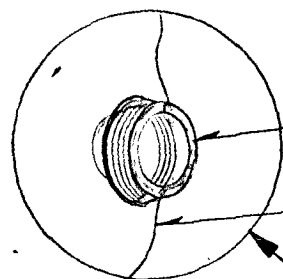
11. Complete assembly by screwing the rear nut into the Connector Shell--tighten carefully with channellock pliers.
12. Slide the Adapter forward and screw into the Connector Shell.
13. Wrap a "pigtail" wire from the Adapter around each of the bare tinned cable leads and solder both connections. Care must be taken to not damage the wire insulation of the other conductors.
14. Slide the Outer Housing forward and screw into the Adapter and tighten Outer Housing-Adapter Assembly.
15. Slide the Tined Ferrule forward, then slide the Compression Nut forward, pull on cable to remove the wire slack inside the back shell, and then screw on the Compression Nut and tighten with a wrench. The cable and Connector Shell must be carefully constrained to prevent rotation of the cable. (A fixture should be designed to capture the cable during this operation. The cable cannot be held properly by hand.)

VI. Testing

The cable shall be tested for continuity and shorts as follows:

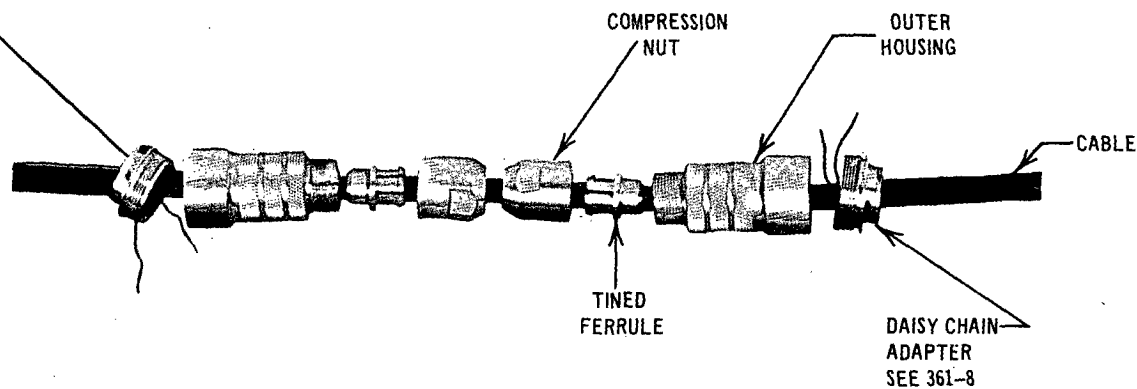
1. Each pin shall be connected to the pin of the same number on the opposite end with a resistance of less than one ohm.
2. Pins 1 through 11 shall be isolated from each other by a resistance greater than one megohm.
3. The resistance between pins 1 and 12, measured at both ends of the cable, shall be less than 1 ohm.

CHG.	E.C.O.	DATE	APPR.
B	0270	10-17-72	<i>scj</i>

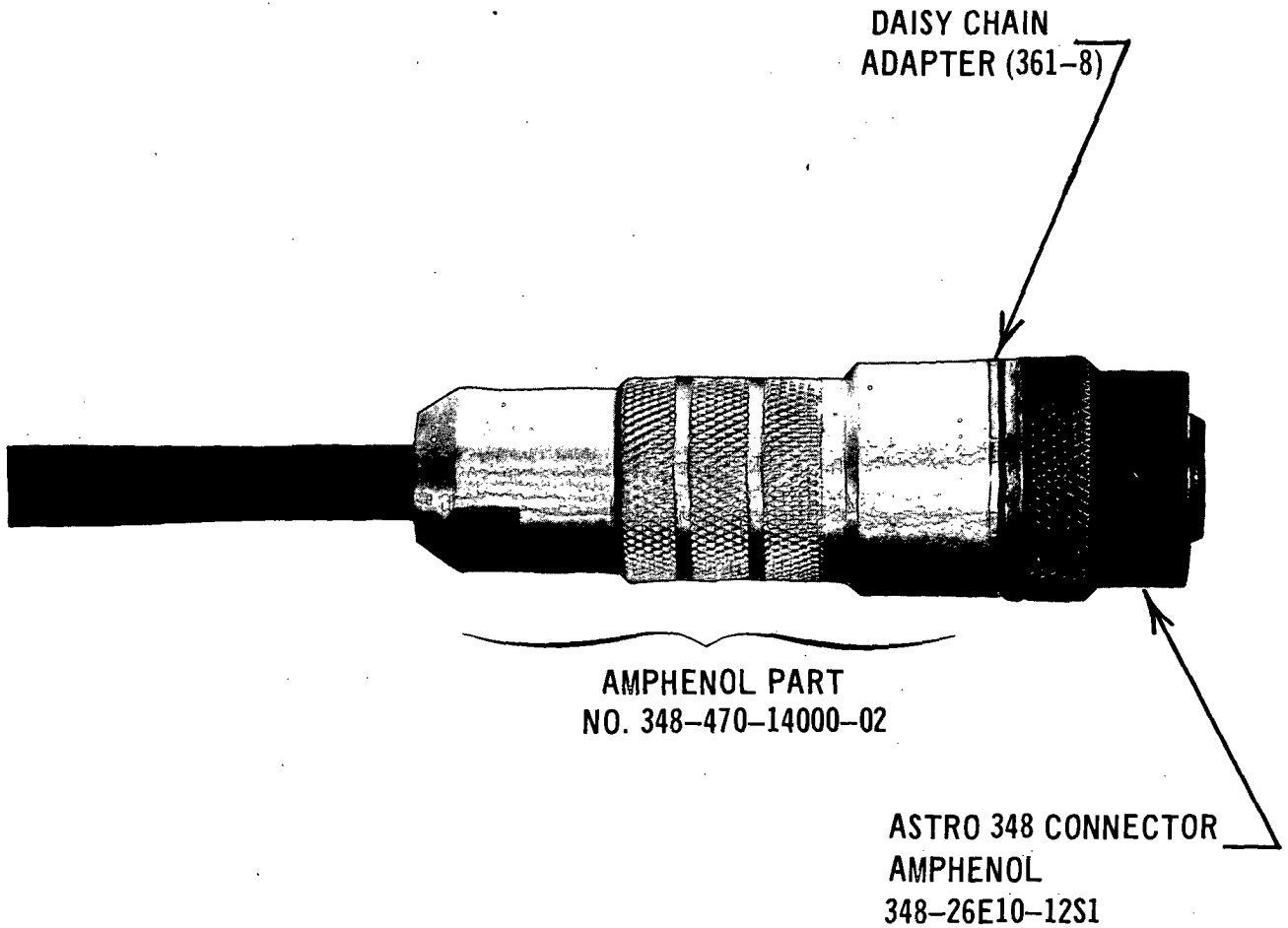


NOTES:

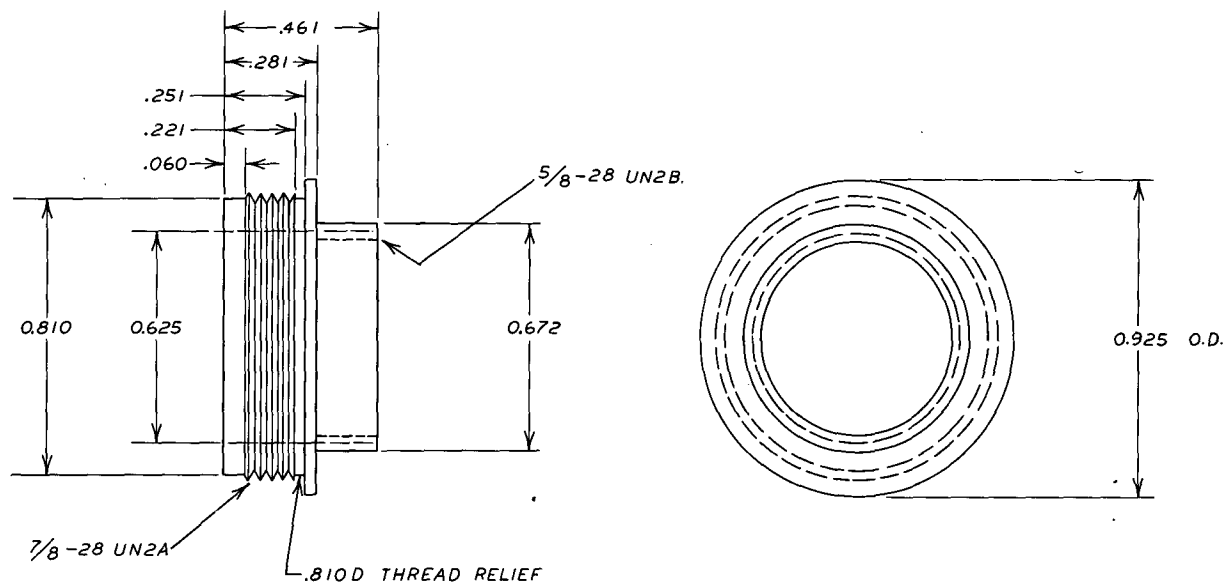
1. SOLDER MUST BE CLEAR OF THREADS.
2. WIRE SOLDERED 1/3 OF CIRCUMFERENCE MIN.
3. "PIGTAIL" LEADS 1" TO 1 1/2" LONG.



B	10-17-72	E.C.O. 0270 <i>GCJ</i>	COMPUTER SYSTEMS LABORATORY WASHINGTON UNIVERSITY ST. LOUIS, MISSOURI	TITLE DAISY CHAIN CABLE ASSEMBLY SEQUENCE PICTORIAL			
ISSUE 12-7-70 <i>GCJ</i>			APPROVED BY <i>GCJ</i> FOR PROD. DATE 12-7-70				
CHANGE NO. DATE DESCRIPTION			MACROMODULAR PROJECT	ENG. <i>GCJ</i> DRAWN BY <i>DLS</i>			
				CHECKED <i>GCJ</i> DATE 12-7-70			



COMPUTER SYSTEMS LABORATORY WASHINGTON UNIVERSITY ST. LOUIS, MISSOURI			MACROMODULAR PROJECT		
			TITLE DAISY CHAIN CABLE HEAD		
			APPROVED		ENG GCJ
			BY GCJ	FOR PROD.	DATE 12-7-70
					DRAWN BY DLS
ISSUE 12-7-70 GCJ					DRAWING NO 361-7
CHANGE NO	DATE	DESCRIPTION	CHECKED GCJ		DATE 12-7-70

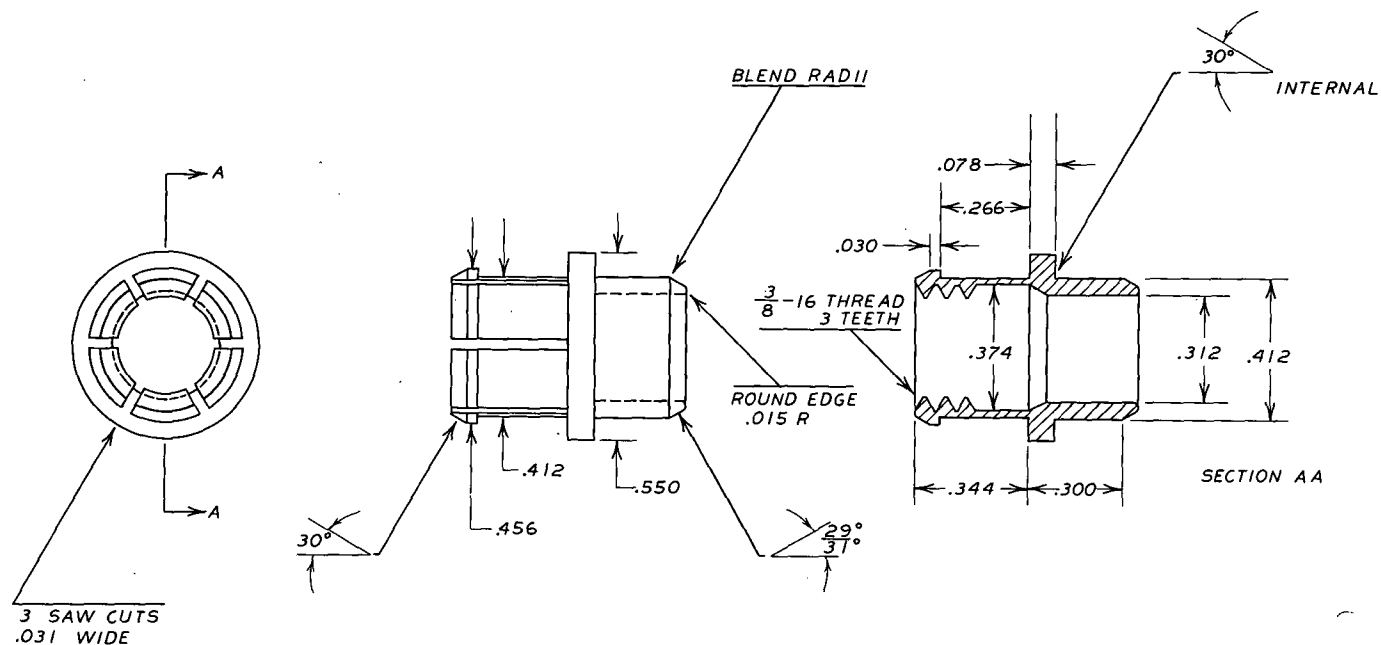


MATERIAL: 6061-T6 ALUMINUM
DIMENSIONS: ± 0.005

MACHINED PARTS SHALL BE GIVEN THE
FOLLOWING FINISH:

CADIUM PLATE (0.0002-0.0004 INCHES THICK)
OVER NICKEL PLATE (0.0001-0.0002 INCHES THICK)
FOLLOWED BY CLEAR CHROMATE CONVERSION.

CHANGE NO.	DATE	DESCRIPTION
A	12-29-70	E.C.Q. 0137
ISSUE	12-7-70	E.C.Q. 0124
COMPUTER SYSTEMS LABORATORY WASHINGTON UNIVERSITY ST. LOUIS, MISSOURI		
MACROMODULAR PROJECT		
TITLE CABLE HEAD ADAPTER BASE PEDESTAL DAISY CHAIN		
BY	APPROVED	ENG.
9107	FOR	GCJ
PROD.	DATE	DRAWING NO.
12-7-70	PLL	361-8
CHECKED	DATE	
9107	12-7-70	



DEBURR, BREAK SHARP EDGES 0.010
ALL DIMENSIONS $\pm .005$
MATERIAL: 6061-T6 ALUM
ALL ANGLES ± 2 DEGREES EXCEPT
AS NOTED

DO NOT SCALE

D 2-5-74		ECO 0304		GCJ	
CHANGE NO.	DATE	DESCRIPTION			
COMPUTER SYSTEMS LABORATORY					
WASHINGTON UNIVERSITY					
ST. LOUIS, MISSOURI					
MACROMODULAR PROJECT					
TITLE					
CABLE HEAD TINED FERRULE					
APPROVED		ENG.		DRAWING NO.	
BY	FOR	DATE	GCJ	361-9	
GCJ	PROP	11-1-70	PLL		
CHECKED			GCJ	DATE	9-15-70

FUNCTION CALLER CABLE MANUFACTURE AND SPECIFICATIONS

The intent of this document (363) is to set forth manufacturing specifications for mechanical parts relating to the function caller cable head. To this end the following pages are a complete set of mechanical drawings fully describing all aspects of the individual cable head components. Strict adherence to component tolerance and finish specifications by the manufacturer must be exercised to produce acceptable assemblies. The manufacturer must assure himself that his facility can meet these specifications by analysis of component and assembly documentation, his tooling and characteristics of his production processes.

TABLE A

PART NO.1 .070 DIA x .200 DEEP AS
MOLDED 4 PLACES FROM
SIDE SHOWN.

PART NO.2 DRILL NO.43 C'BORE .170 x
.100 DEEP 4 PLACES AS
SHOWN.

ONE PART NO.1 AND ONE
PART NO.2 REQ'D. PER
ASSEMBLY.

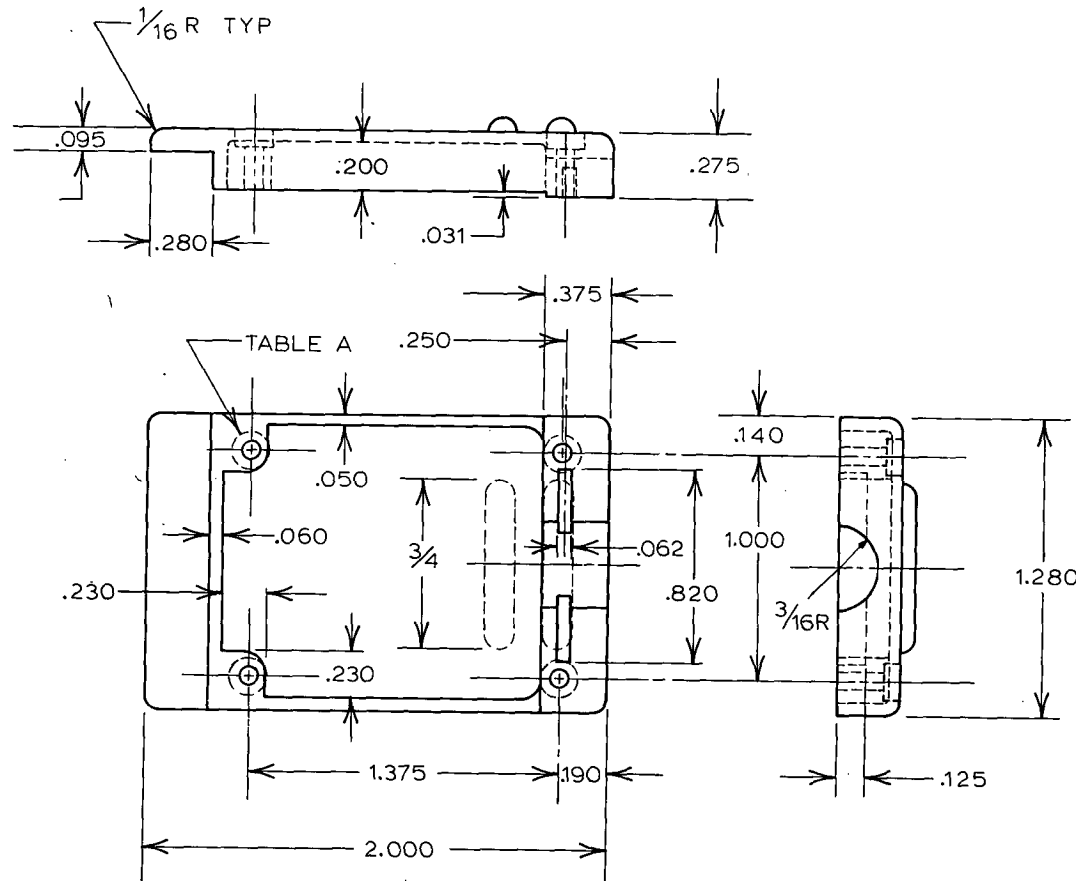
MAT'L: INJECTION MOLDED ABS
COLOR: BLACK

DIMENSIONS SHOWN ARE MOLD DIMENSIONS
TOLERANCES UON:

.XXX ±.005

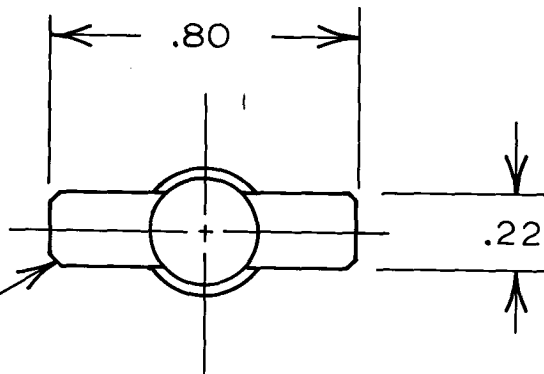
.XX ±.010

$\frac{X}{X} \pm \frac{1}{64}$

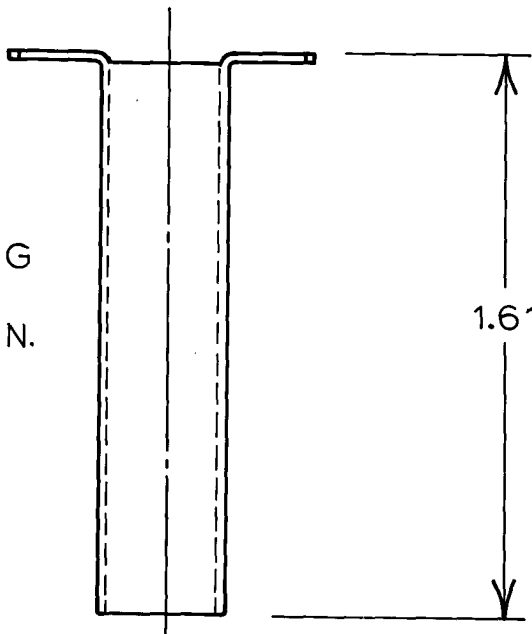


ISSUE			
CHANGE NO.	DATE	DESCRIPTION	
COMPUTER SYSTEMS LABORATORY WASHINGTON UNIVERSITY ST. LOUIS, MISSOURI			
MACROMODULAR PROJECT			
TITLE FUNCTION CALLER CABLE HEAD COVER			
APPROVED		ENG.	DRAWING NO.
BY	FOR	GCM	363-3
RJA	PROD	DRAWN BY	PL
		CHECKED	DATE
		GCM	9-12-73

BREAK
CORNERS $.02 \times 45^\circ$



MAT'L: $.375 \pm .005$
FLEXIBLE
COPPER TUBING
DIMENSIONS: $\pm .010$ U.O.N.



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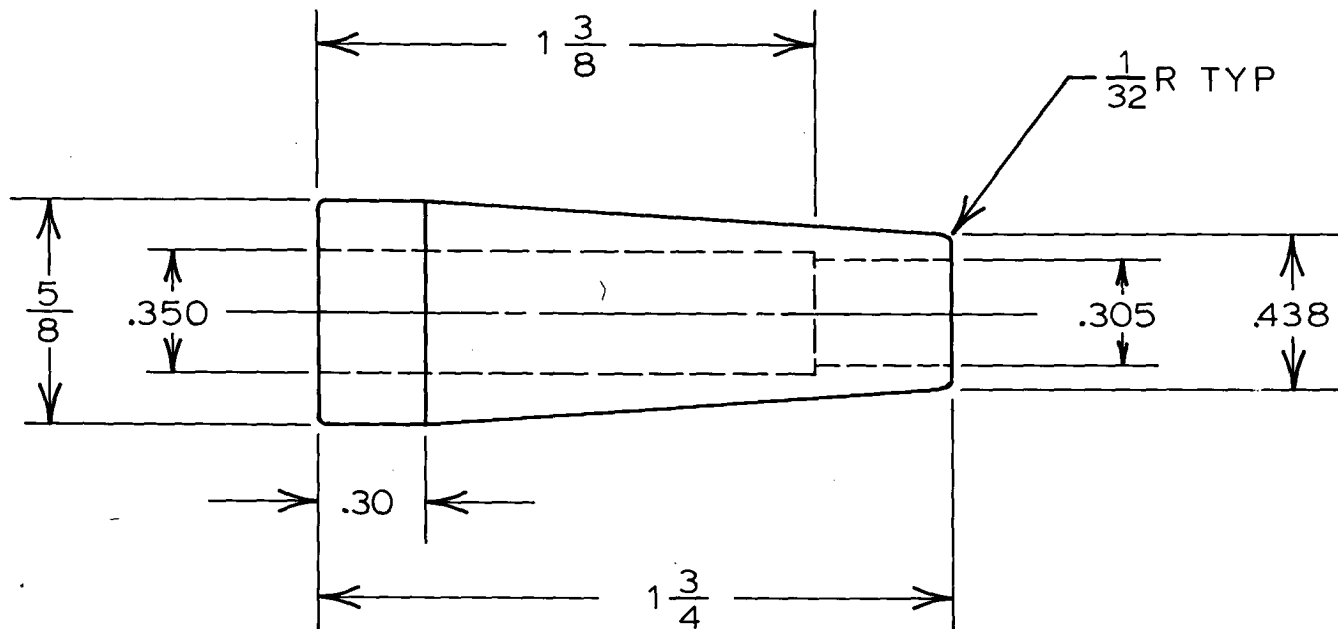
MACROMODULAR PROJECT

TITLE

COPPER STRAIN RELIEF

ISSUE		
CHANGE NO.	DATE	DESCRIPTION

APPROVED			ENG	DRAWING NO.
BY	FOR	DATE	RJA	
RJA	PROD	10-4-73	DRAWN BY	363-4
			CHECKED	DATE
			GM	
				9-12-73



MAT'L: MOLDED VINYL
 PART A COLOR - BLACK
 PART B COLOR - GREEN

DIMENSIONS U.O.N.

.XXX $\pm .005$

.XX $\pm .010$

$\frac{X}{X} \pm \frac{1}{64}$

COMPUTER SYSTEMS LABORATORY
 WASHINGTON UNIVERSITY
 ST. LOUIS, MISSOURI

MACROMODULAR PROJECT

TITLE

STRAIN RELIEF HANDLE GRIP

APPROVED

ENG

RJA

DRAWING NO.

BY

FOR

DATE

RJA

PROD

10-4-73

DRAWN BY

PLL

363-5

CHECKED

GM

DATE

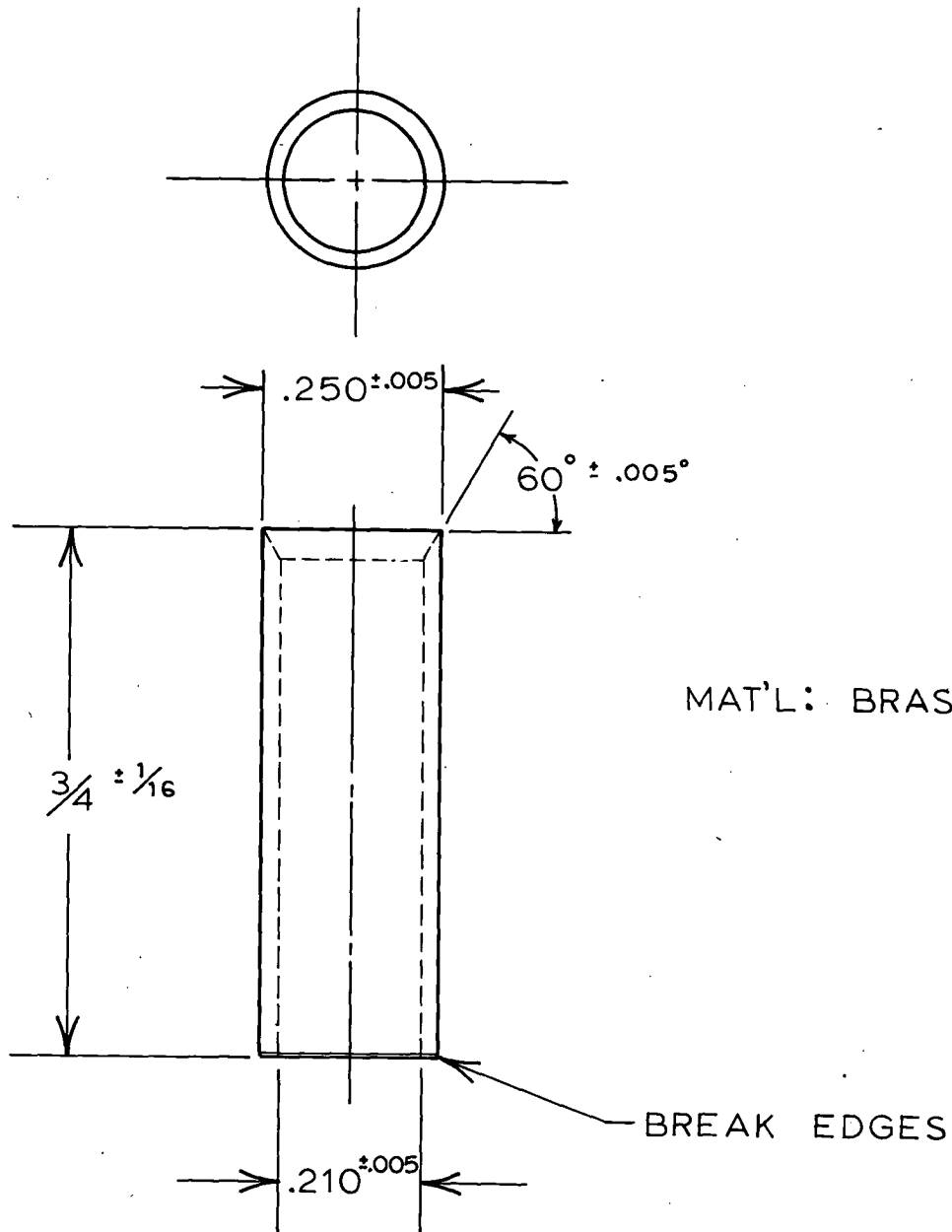
9-12-73

ISS

CHANGE
NO.

DATE

DESCRIPTION



COMPUTER SYSTEMS LABORATORY WASHINGTON UNIVERSITY ST. LOUIS, MISSOURI			MACROMODULAR PROJECT				
			TITLE BRASS SLEEVE				
ISS			APPROVED			ENG	DRAWING NO.
			BY	FOR	DATE	RJA	363-6
			RJA	PROD	10-4-73	DRAWN BY	
			CHECKED	DATE		PLL	
CHANGE NO.	DATE	DESCRIPTION				CHECKED <i>GM</i>	DATE 9-12-73

COMPUTER SYSTEMS LABORATORY
WASHINGTON UNIVERSITY

364

FUNCTION CALLER CABLE
CIRCUIT BOARD SUB-SUBASSEMBLY

PAGE	TITLE	CHANGE
364-1	TITLE PAGE	A
364-2	ASSEMBLY SPECIFICATION	
364-3	P.C. BOARD PARTS LIST - RECEIVING END	
364-4	COMPONENT IDENTIFICATION - A SIDE - RECEIVING END	
364-5	COMPONENT IDENTIFICATION - B SIDE - RECEIVING END	
364-6	HOLE LOCATIONS - RECEIVING END	
364-7	LOGIC DRAWING - RECEIVING END	A
364-8	P.C. BOARD PARTS LIST - TRANSMITTING END	
364-9	COMPONENT IDENTIFICATION - A SIDE - TRANSMITTING END	
364-10	COMPONENT IDENTIFICATION - B SIDE - TRANSMITTING END	
364-11	HOLE LOCATIONS - TRANSMITTING END	
364-12	LOGIC DRAWING - TRANSMITTING END	

CHG.	E.C.O.	DATE	APPR.
Iss.		10-4-73	MTK
A	0298	10-24-73	M.L.P.

MACROMODULAR SYSTEMS PROJECT

ASSEMBLY SPECIFICATIONS

I. P.C. Board Assembly

- A. Two printed circuit boards are used - one for each end of the cable. The boards - WCL0211 and WCL0213 - have plated-through holes and gold plated fingers conforming to specifications in PC-1. (See Document 010.)
- B. All of the Corning 1% resistors are mounted on .4 inch centers. The leads should be bent so that the value may be easily read.
- C. WCL-0211-2
 - 1. Refer to pages 364-4 and 364-5 for component orientation.
 - 2. Insert MECL package from B side and solder on A side.
 - 3. Insert R1 to R8 from A side and solder on B side. Note that one lead of R6 is very close to the MECL package. Solder this lead very carefully on the B side or solder from the A side letting solder flow through the hole.
 - 4. Insert C1 from A side and solder on B side. This capacitor lies on top of R3 and R4.
 - 5. Insert the LTN-2 from the A side. Bend the leads so that the top and bottom edges of the LTN-2 are just clear of the MECL pins, and solder on the B side.
- D. WCL0213-2
 - 1. Refer to pages 364-9 and 364-10 for component orientation.
 - 2. Insert the MECL packages from the B side and solder on the A side.
 - 3. Insert R1, R2 and R3 from the A side and solder on the B side.
 - 4. Insert C1 from the A side, bending it over so that it just clears the MECL pins. Solder on the B side.

INTEGRATED CIRCUIT

P1 = M20

RESISTORS

N01 = LTN2

R01 thru R04 = 121 Ohm 1% Corning RN55D
R05 thru R08 = 1.1K 5% 1/8 W Carbon Comp.

CAPACITOR

C01 = .018 MF Sprague 262C067183X0500B
(192C substitute)

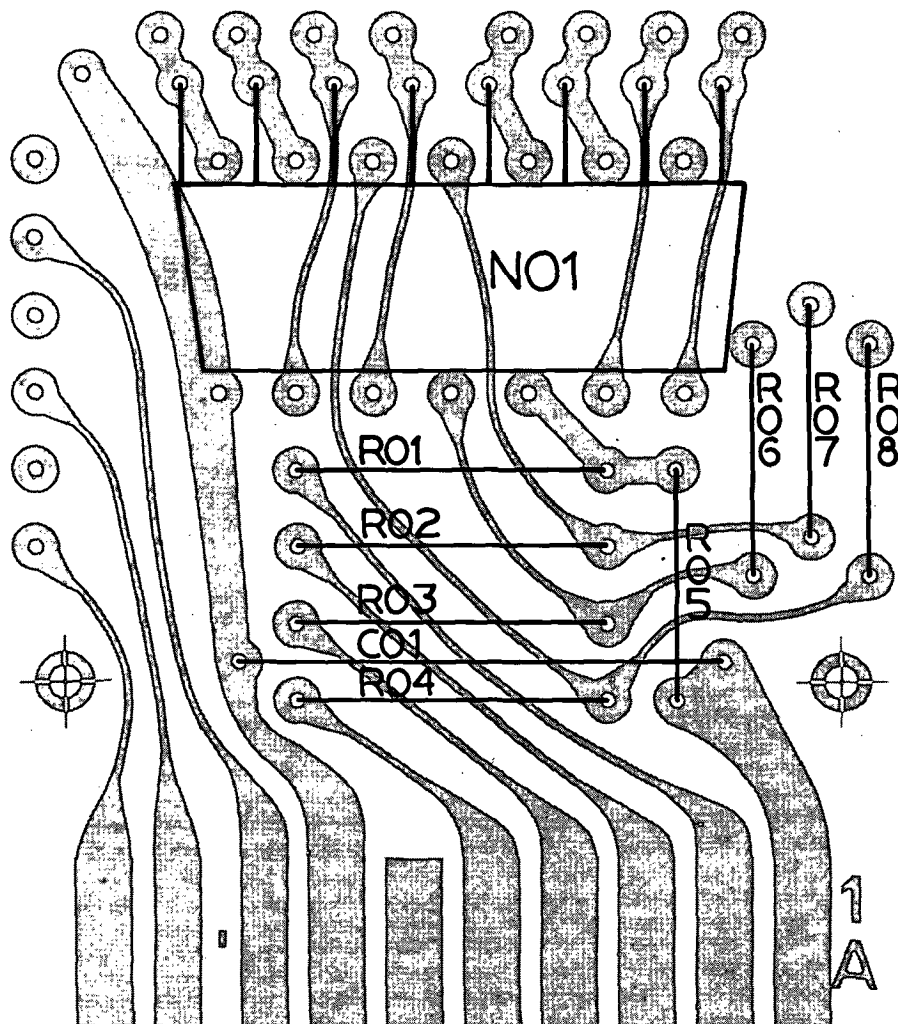
PRINTED CIRCUIT BOARD

WCL0211-2

COMPUTER SYSTEMS LABORATORY WASHINGTON UNIVERSITY ST. LOUIS, MISSOURI			MACROMODULAR PROJECT				
			TITLE Parts List Receiving End				
			APPROVED			ENG MLP	DRAWING NO. 364-3
			BY MTK	FOR PROD	DATE 10-9-73	DRAWN BY CAH	
			CHANGE NO.	DATE	DESCRIPTION		CHECKED MLP
Issue	9-12-73						

WCL

0211-2



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WASHINGTON UNIVERSITY
ST. LOUIS, MISSOURI

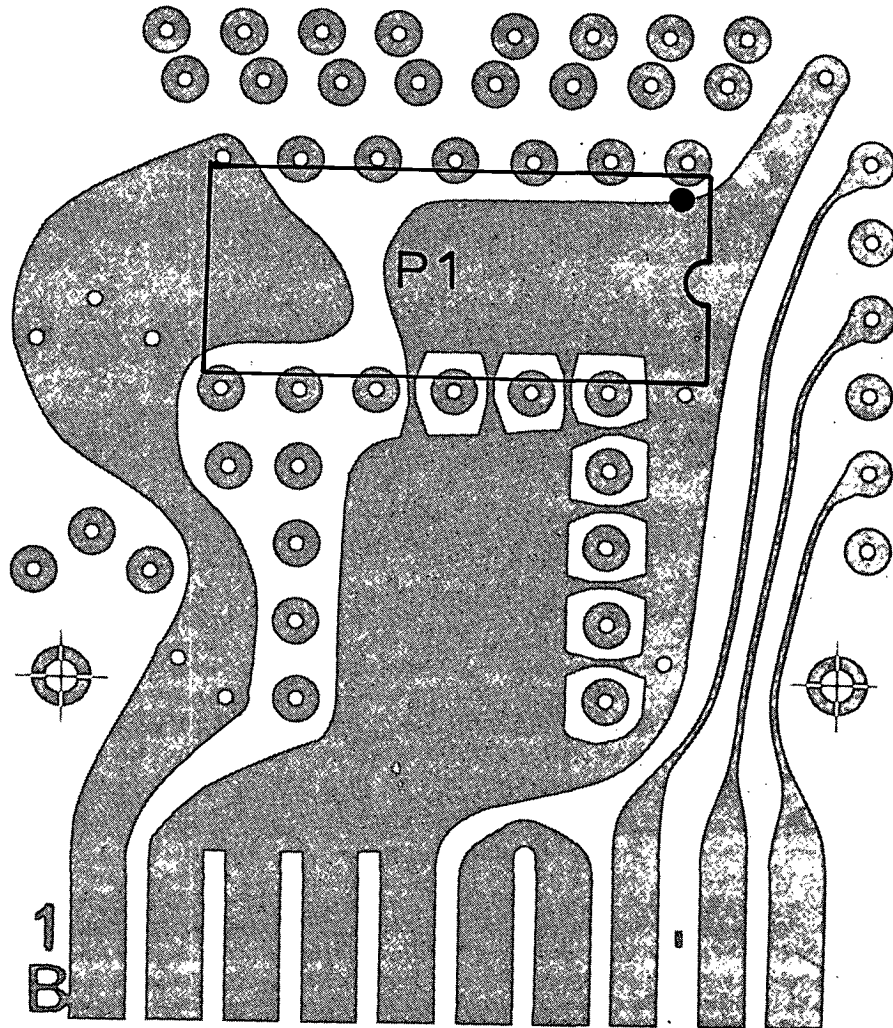
MACROMODULAR PROJECT

TITLE
Component Identification
A Side Receiving End

Issue	9-12-73		APPROVED			ENG MLP	DRAWING NO. 364-4
			BY WTR	FOR PROD	DATE 10-4-73	DRAWN BY CAH	
CHANGE NO.	DATE	DESCRIPTION				CHECKED MLP	DATE 9-12-73

WCL

0211-2



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MACROMODULAR PROJECT

TITLE

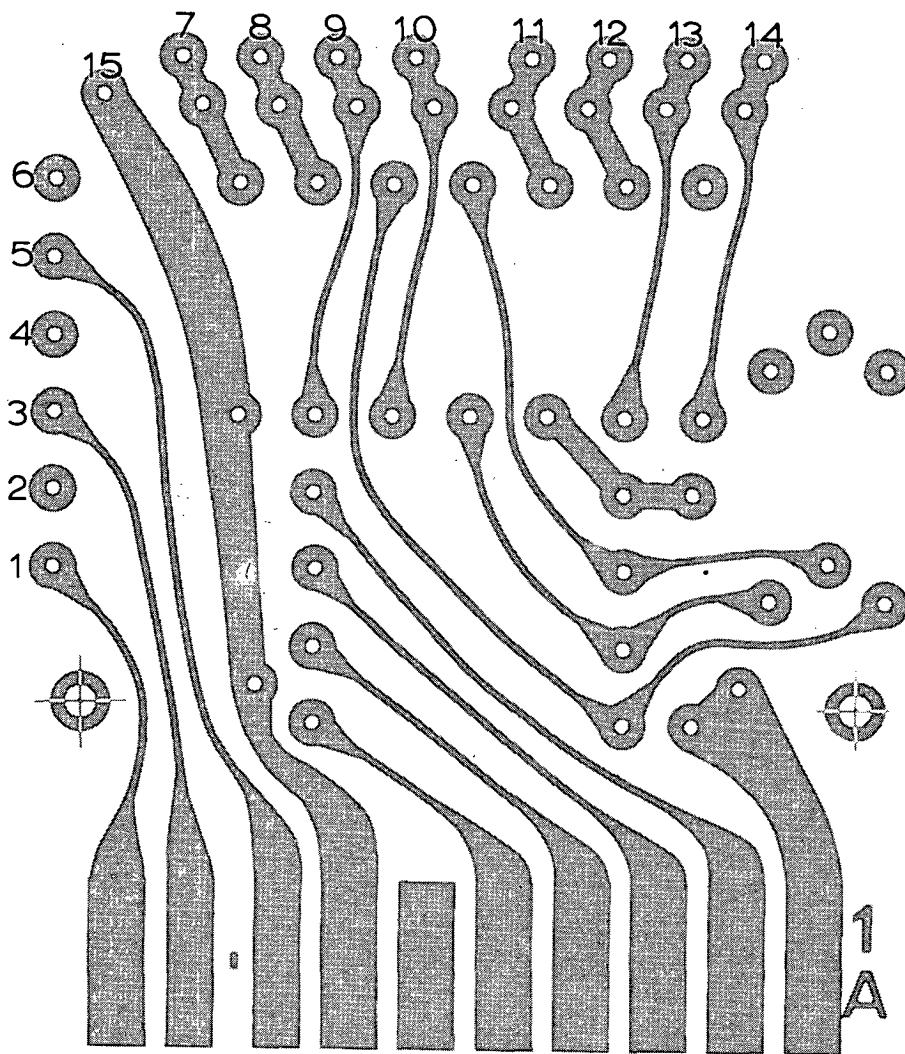
Component Identification
B Side Receiving End

Issue	9-12-73	
CHANGE NO.	DATE	DESCRIPTION

APPROVED			ENG	DRAWING NO.
BY	FOR	DATE	MLP	364-5
<i>MLP</i>	PROD	10-4-73	DRAWN BY CAH	
			CHECKED <i>MLP</i>	DATE 9-12-73

WCL

0211-2



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WASHINGTON UNIVERSITY
ST. LOUIS, MISSOURI

MACROMODULAR PROJECT

TITLE
HOLE LOCATIONS
RECEIVING END

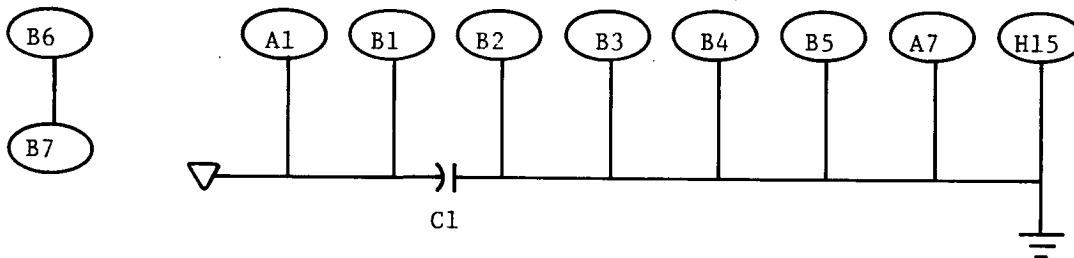
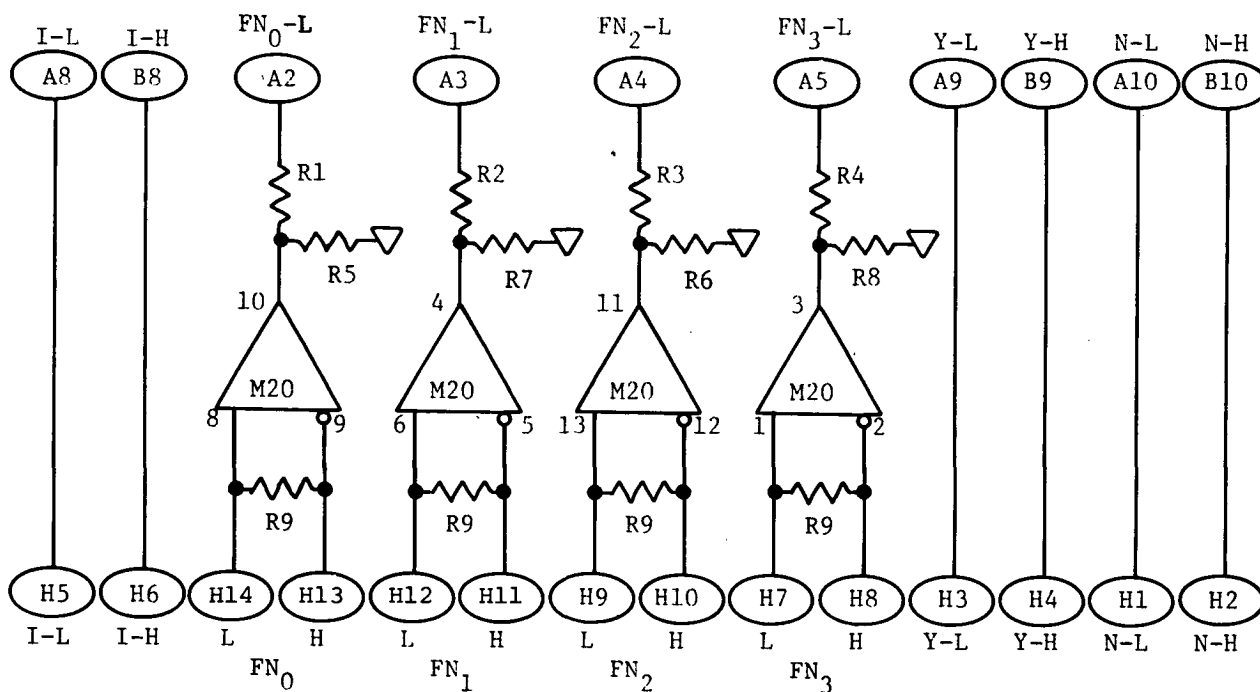
APPROVED			ENG MLP	DRAWING NO. 364-6
BY <i>WIK</i>	FOR PROD	DATE 10-4-73	DRAWN BY DLS	
			CHECKED <i>MLP</i>	DATE 9-12-73

ISS

CHANGE
NO.

DATE

DESCRIPTION



C1 = .018 MF

R5 - R8 = 1.1 K 1/8 W 5% carbon comp.

R1 - R4 = 121 Ω 1/8 W 1% RN55D

R9 = LTN-2

Printed Circuit Board
WCL0211-2

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WASHINGTON UNIVERSITY
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MACROMODULAR PROJECT

TITLE

Logic Drawing - Receiving End

APPROVED

BY

FOR

DATE

ENG

MLP

DRAWING NO.

DRAWN BY

PLL

364-7

CHECKED

MLP

DATE

9-12-73

A

10-24-73

E.C.O. 0298

CHANGE
NO.

DATE

DESCRIPTION

INTEGRATED CIRCUIT

P1 = M35

RESISTORS

R01 = 130 Ohms 1% Corning RN55D

R02, R03 = 57.6 Ohms 1% Corning RN55D

CAPACITOR

C01 = .01 uf Sprague

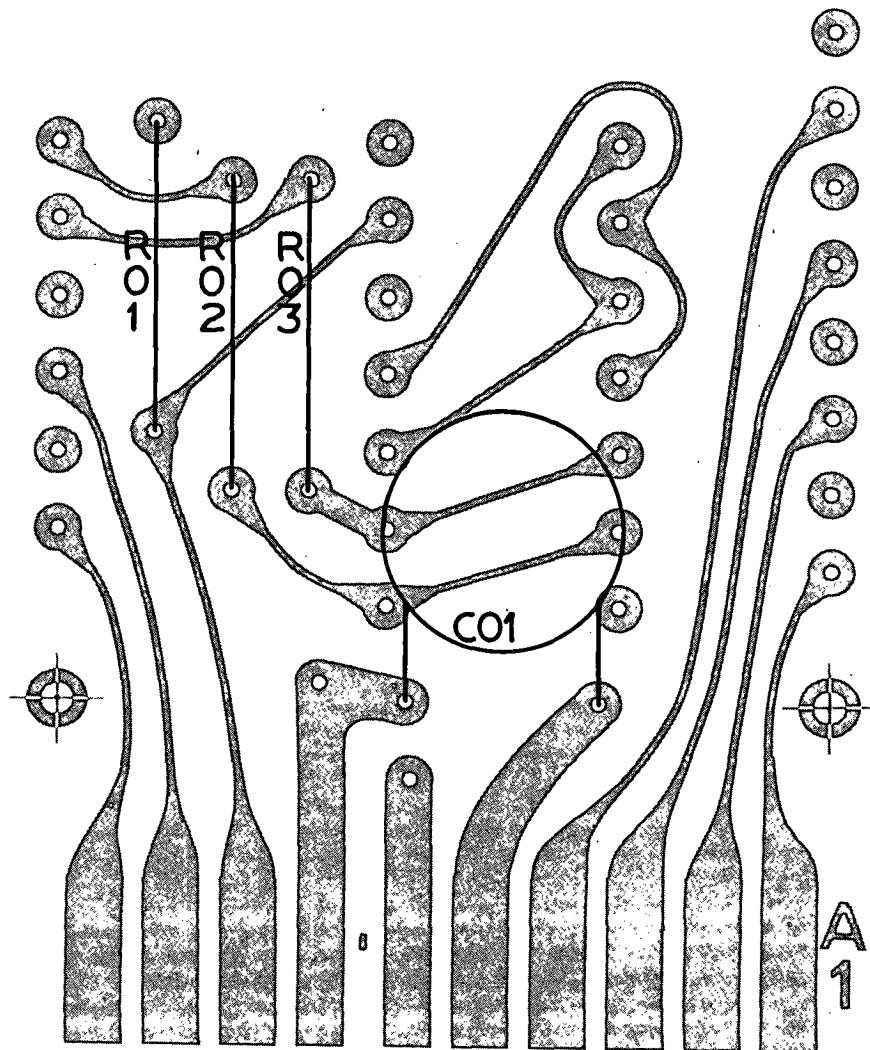
PRINTED CIRCUIT BOARD

WCL0213-2

COMPUTER SYSTEMS LABORATORY WASHINGTON UNIVERSITY ST. LOUIS, MISSOURI			MACROMODULAR PROJECT				
			TITLE Parts List Transmitting End				
Issue	9-12-73		APPROVED			ENG MLP	DRAWING NO. 364-8
			BY ZTR	FOR PROD	DATE 10-4-73	DRAWN BY CAH	
			CHANGE NO.	DATE	DESCRIPTION		

W C L

0213-2



COMPUTER SYSTEMS LABORATORY
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ST. LOUIS, MISSOURI

MACROMODULAR PROJECT

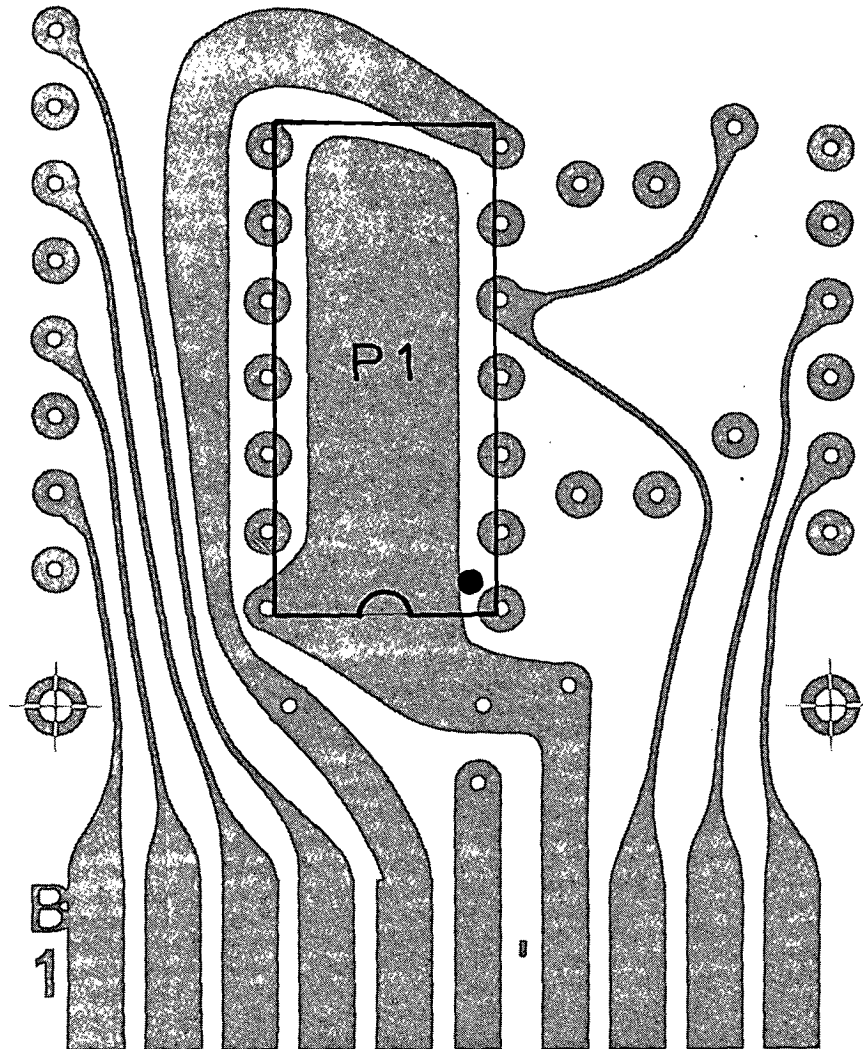
TITLE
Component Identification
A Side Transmitting End

Issue	9-12-73	
CHANGE NO.	DATE	DESCRIPTION

APPROVED			ENG MLP	DRAWING NO. 364-9
BY ZIK	FOR PROD	DATE 10-4-73	DRAWN BY CAH	
			CHECKED MLP	DATE 9-12-73

WCL

0213-2



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WASHINGTON UNIVERSITY
ST. LOUIS, MISSOURI

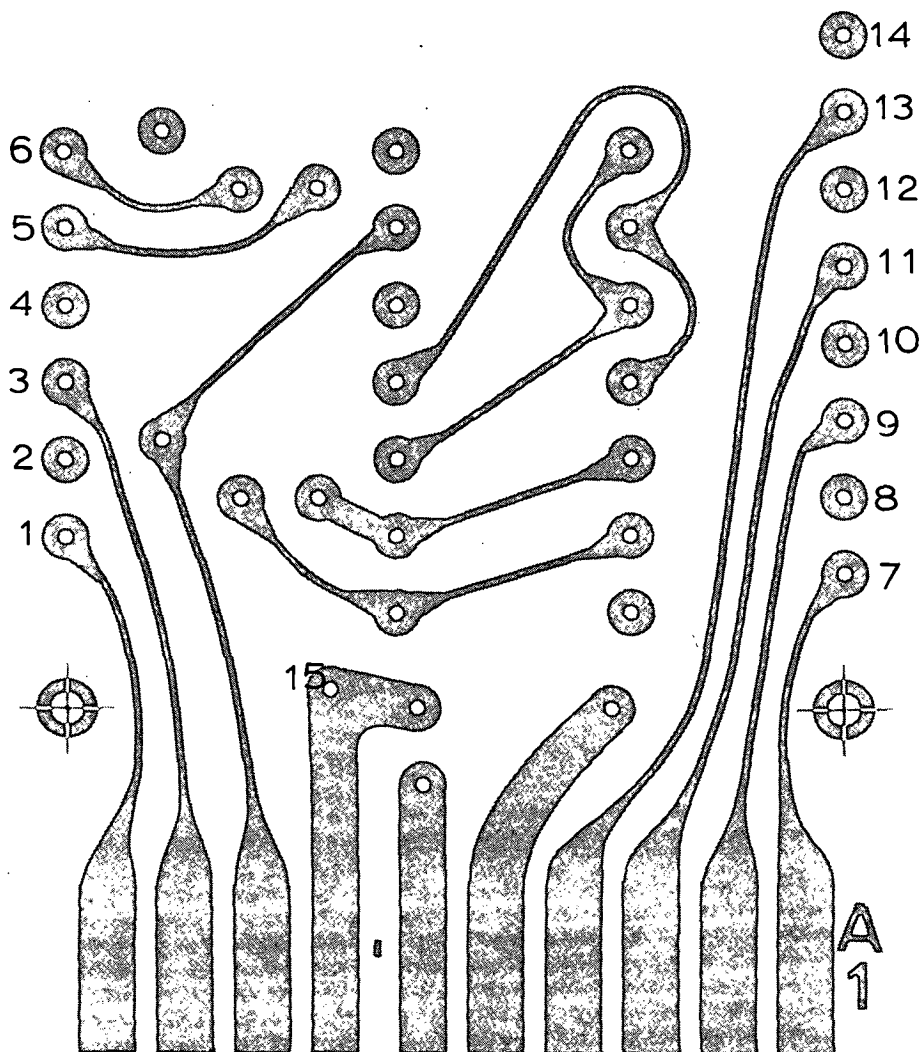
MACROMODULAR PROJECT

TITLE
Component Identification
B Side Transmitting End

Issue	9-12-73		APPROVED			ENG MLP	DRAWING NO. 364-10
			BY ZITR	FOR PROD	DATE 10-4-73	DRAWN BY CAH	
CHANGE NO.	DATE	DESCRIPTION				CHECKED MLP	DATE 9-12-73

W C L

0213-2



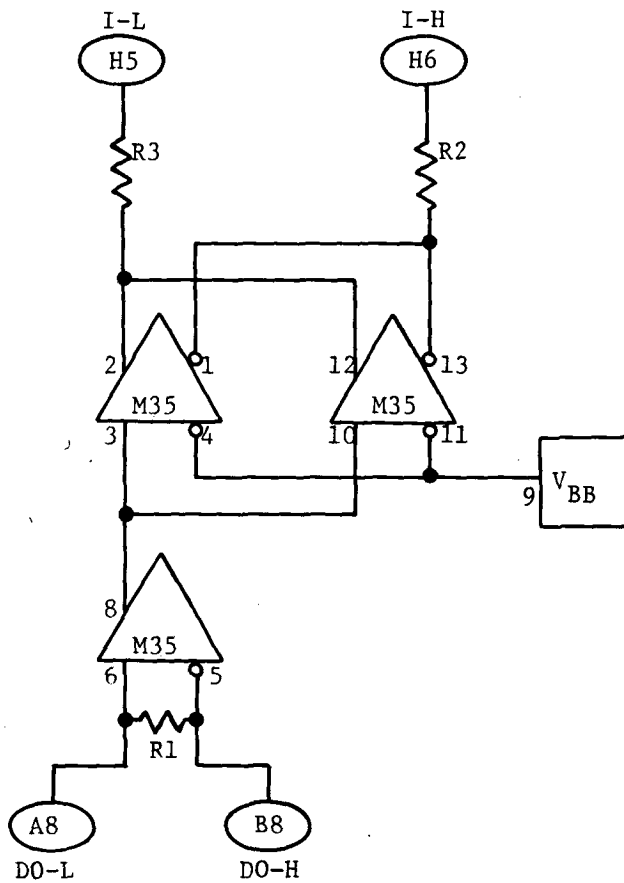
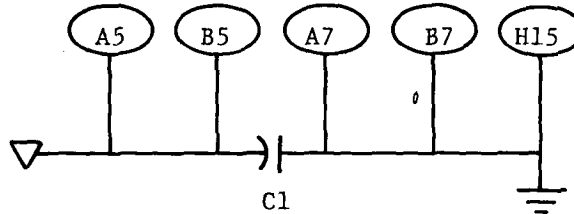
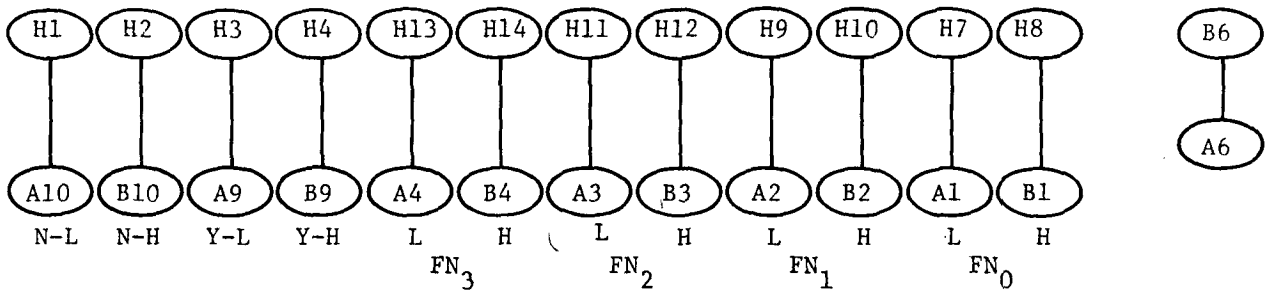
COMPUTER SYSTEMS LABORATORY
WASHINGTON UNIVERSITY
ST. LOUIS, MISSOURI

MACROMODULAR PROJECT

TITLE
HOLE LOCATIONS
TRANSMITTING END

ISS		
CHANGE NO.	DATE	DESCRIPTION

APPROVED			ENG MLP	DRAWING NO. 364-11
BY <i>WTR</i>	FOR PROD	DATE 10-4-73	DRAWN BY PLL	
			CHECKED <i>MLP</i>	DATE 9-12-73



$C1 = .01 \text{ MF}$
 $R1 = 130 \Omega$
 $R2, R3 = 57.6 \Omega$

1/8 W 1% RN55D

Printed Circuit Board
WCL0213-2

COMPUTER SYSTEMS LABORATORY
WASHINGTON UNIVERSITY
ST. LOUIS, MISSOURI

MACROMODULAR PROJECT

TITLE

Logic Drawing - Transmitting End

APPROVED

ENG

DRAWING NO.

BY

FOR

DATE

MLP

364-12

DRAWN BY

PLL

CHECKED

MLP

DATE

9-12-73

CHANGE
NO.

DATE

DESCRIPTION

COMPUTER SYSTEMS LABORATORY

WASHINGTON UNIVERSITY

FUNCTION CALLER CABLE ASSEMBLY

PAGE	TITLE	CHANGE
365-1	TITLE PAGE	A
365-2	PARTS LIST	
365-3 thru 365-5	INTRODUCTION AND ASSEMBLY PROCEDURES	
365-6	CABLE ASSEMBLY	
365-7	WIRING CHART - RECEIVING END	A
365-8	WIRING CHART - TRANSMITTING END	
365-9	COPPER STRAIN RELIEF VICE	
365-10	SWAGING TOOL	
365-11	WINDOW & SHORT HEAD COVER ASSEMBLY JIG	

CHG.	E.C.O.	DATE	APPR.
Issue		9-4-73	RJA
A	0298	10-24-73	msf

MACROMODULAR SYSTEMS PROJECT

PARTS LIST

QTY	C.S.L. DOC.	PART
1	364	PRINTED CIRCUIT BOARD WCL-0211-2
1	364	PRINTED CIRCUIT BOARD WCL-0213-2
2	363-3	HEAD COVER PART NO. 1
2	363-3	HEAD COVER PART NO. 2
2	363-4	COPPER STRAIN RELIEF
1	363-5	STRAIN RELIEF HANDLE GRIP TYPE A
1	363-5	STRAIN RELIEF HANDLE GRIP TYPE B
2	363-6	BRASS SLEEVE
8	-----	2-56 SELF THREADING FILLISTER HEAD SCREWS 3/8"LONG
	-----	DATA CABLE (SEE PAGE 365-3, SECTION II)
1	365-11	WINDOW COVER ASSEMBLY JIG
1	365-11	SHORT COVER ASSEMBLY JIG

CHG.	E.C.O.	DATE	APPR.
Issue		9-4-73	RJA

MACROMODULAR SYSTEMS PROJECT

ASSEMBLY PROCEDURE

FUNCTION CALLER CABLE

1. Introduction

This document describes the procedure for assembling the Function Caller Cable. This cable carries seven twisted pairs of high speed digital data in a length of multiconductor, jacketed cable terminated by active cable head connectors at each end. The cable heads each contain one digital integrated circuit; they are of similar mechanical design, but each is distinct electrically.

II. Cable Stock

Macromodular Data Cable is used for the Function Caller Cable. The cable is described by CAS-5 (refer to Document 010).

III. Wiring P.C. Board to Cable

A. Cable Nomenclature (See page 365-6.)

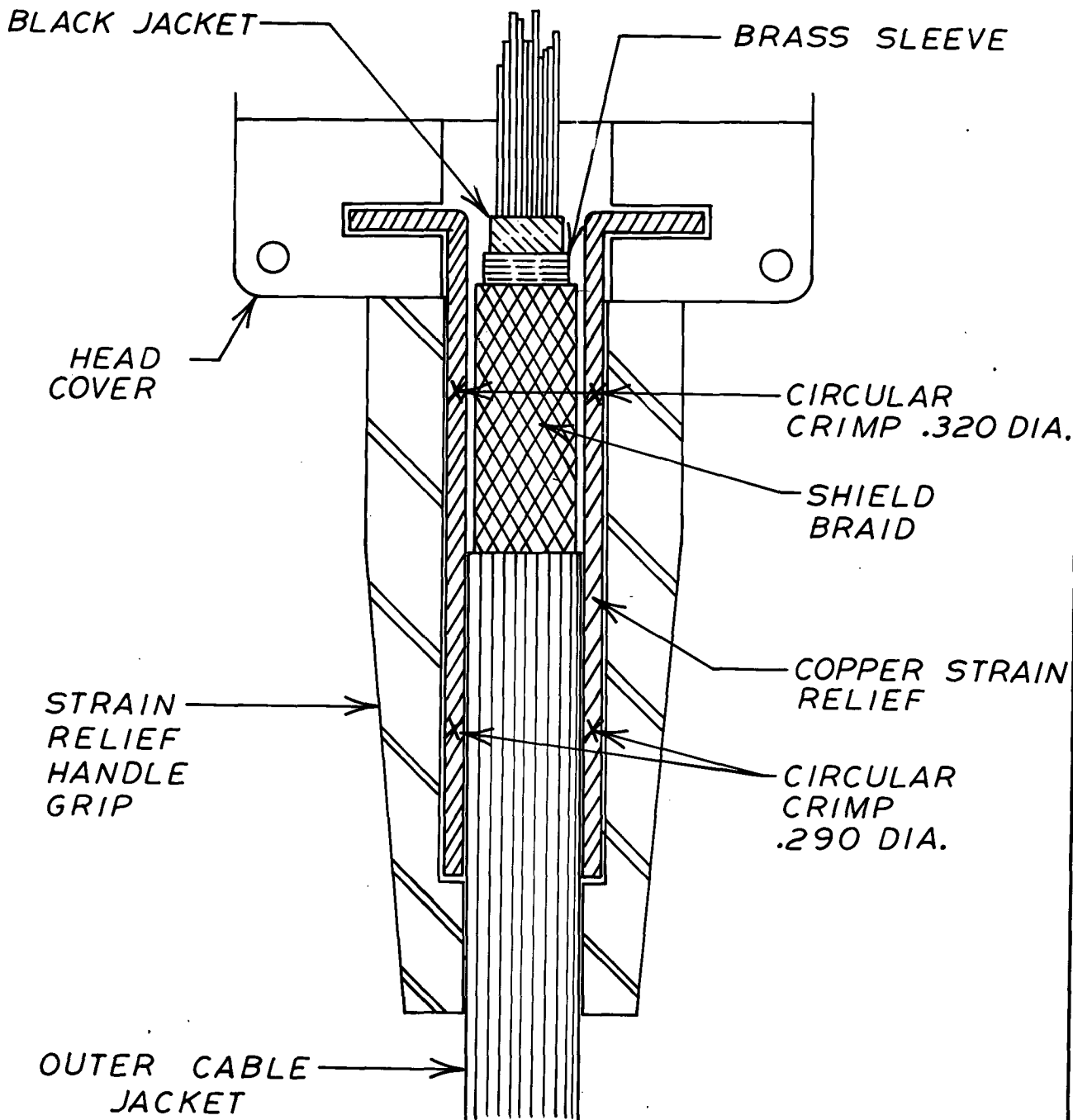
1. The outer jacket made of gray PVC will be called the gray jacket.
2. The inner jacket made of black polyethylene will be called the black jacket.
3. The braided copper shield will be called the braid.

B. Assembly

1. Cut cable stock to specified length. Make sure the cut is clean and square.
2. Slide on Strain Relief Handle Grip. (See pages 365-7 and 365-8 for designated color.)

3. Slide on copper Strain Relief.
4. Strip back gray jacket 2.5".
5. Cut braid back to .75".
6. Uncomb braid enough to insert the Brass Sleeve, chamferred end first, under the braid all the way to the gray jacket. Trim braid flush with end of Brass Sleeve.
7. Insert a 2.5" #26 AWG tinned copper wire between the braid and brass sleeve. Slide the Copper Strain Relief up flush with end of Brass Sleeve and braid, and clamp the assembly using the strain relief vice (modified Vise Grip).
8. Place the A side of the swaging tool (modified tube cutter) against the vice and gently touch the roller to the copper Strain Relief. Gradually reduce the tube diameter with this tool until the proper diameter is achieved.
9. Move the swaging tool so that the side of the roller is within 1/4" of the end of the copper Strain Relief and reduce the copper Strain Relief to the proper diameter.
10. Remove the swaged strain relief from the vice.
11. Strip back black jacket and mylar film to 1/16" from end of brass sleeve.
12. Separate wire pairs, and using the charts on page 365-7 and 365-8 cut off the unused pairs flush with the end of the black jacket.
13. Cut the wires to length using the charts on pages 365-7 and 365-8.
14. Strip the wires 1/8" using extreme care not to nick the wires. This is similar to preparation of the Data Cable - see 370-2 and 370-3.

15. Place the cable in the window cover (see page 365-11), the P.C. board (A side toward the window) then goes over that, and the short cover is then screwed to the window cover. Two screws hold the P.C. board in place.
16. Insert the wires into the proper holes from the A side using the charts on pages 365-7 and 365-8. The insulation should just touch the board. The bare wire should be covered with a teflon sleeve. There is adequate clearance that the wires may run over the components, but they must not run farther to the side of the board than the pads.
17. Solder on the B side.
18. Remove the assembly covers and replace with a set of plastic covers so that the 2-56 screws enter from the A side of the P.C. board.



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MACROMODULAR PROJECT

TITLE
CABLE ASSEMBLY

ISS			APPROVED			ENG	DRAWING NO.
			BY	FOR	DATE	RJA	365-6
			RJA	PROD	10-4-73	DRAWN BY	
			CHANGE NO.	DATE	DESCRIPTION	CHECKED	DATE
			GM	9-11-73			

FUNCTION CALLER CABLE
RECEIVING END - WCL0211-2

HOLE #	COLOR PAIR	WIRE LENGTH	NAME
1	Blue	1.4	N-L
2	Yellow	1.3	N-H
3	Blue	1.2	Y-L
4	Violet	1.1	Y-H
5	Orange	1.0	I-L
6	Violet	.9	I-H
7	Orange	.7	FN ₃ -L
8	Red	.7	FN ₃ -H
9	Blue	.7	FN ₂ -L
10	Red	.7	FN ₂ -H
11	Yellow	.7	FN ₁ -H
12	Slate	.7	FN ₁ -L
13	Yellow	.7	FN ₀ -H
14	Orange	.7	FN ₀ -L
15	Bare	.8	Gnd.

HANDLE GRIP COLOR - BLACK

SEE DRAWING NO. 364-6 FOR HOLE LOCATIONS

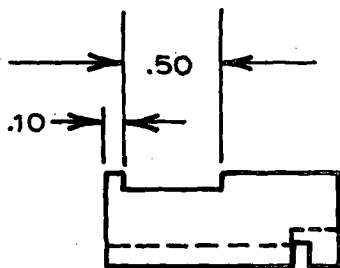
CHG.	E.C.O.	DATE	APPR
A	0298	10-24-73	<i>MLP</i>

FUNCTION CALLER CABLE
TRANSMITTING END - WCL0213-2

HOLE #	COLOR PAIR	WIRE LENGTH	NAME
1	Blue	1.4	N-L
2	Yellow	1.3	N-H
3	Blue	1.2	Y-L
4	Violet	1.1	Y-H
5	Orange	1.0	I-L
6	Violet	.9	I-H
7	Orange	1.4	FN ₀ -L
8	Yellow	1.3	FN ₀ -H
9	Slate	1.2	FN ₁ -L
10	Yellow	1.1	FN ₁ -H
11	Blue	1.0	FN ₂ -L
12	Red	1.0	FN ₂ -H
13	Orange	.9	FN ₃ -L
14	Red	.8	FN ₃ -H
15	Bare	1.5	Gnd.

HANDLE GRIP COLOR - GREEN

SEE DRAWING NO. 364-11 FOR HOLE LOCATIONS



COPPER STRAIN RELIEF VICE JAW
2 REQ'D.

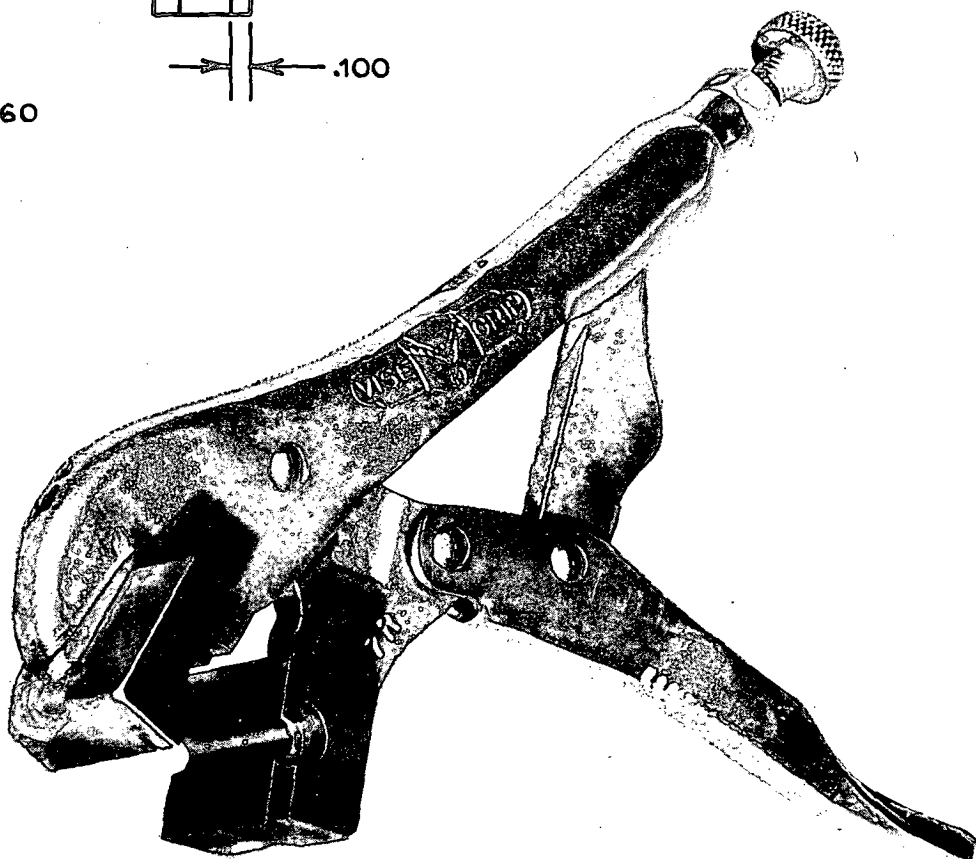
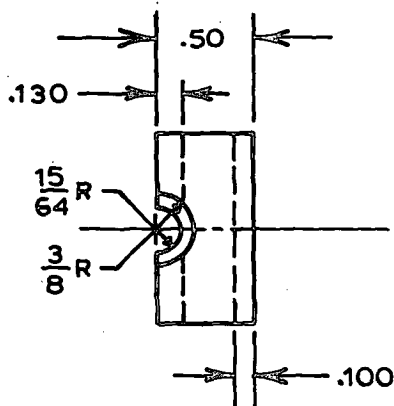
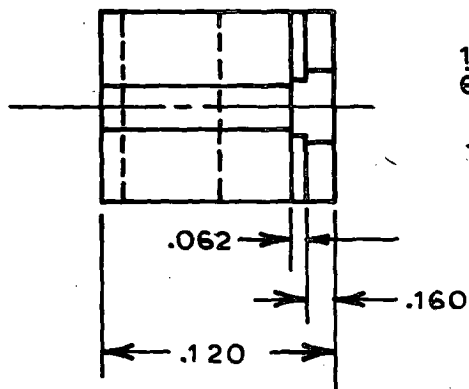
MAT'L. CRS

DIMENSIONS U.O.N.

.XXX $\pm .005$

.XX $\pm .010$

$\frac{X}{X} \pm \frac{1}{64}$



COMPUTER SYSTEMS LABORATORY
WASHINGTON UNIVERSITY
ST. LOUIS, MISSOURI

MACROMODULAR PROJECT

TITLE

COPPER STRAIN RELIEF VICE

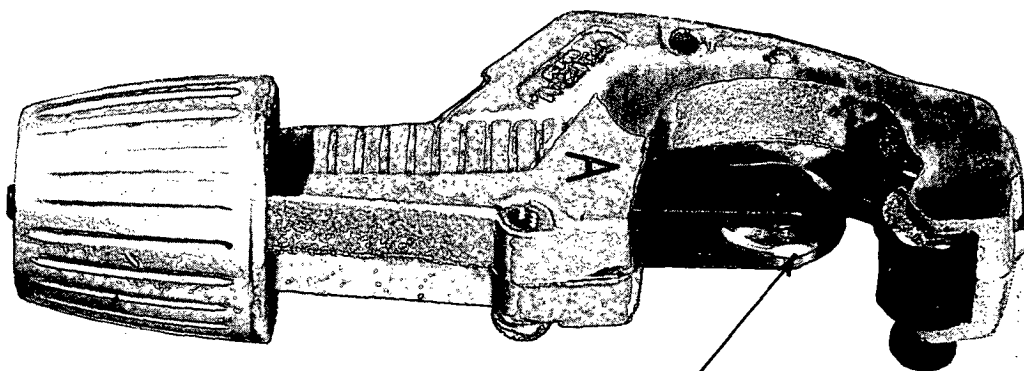
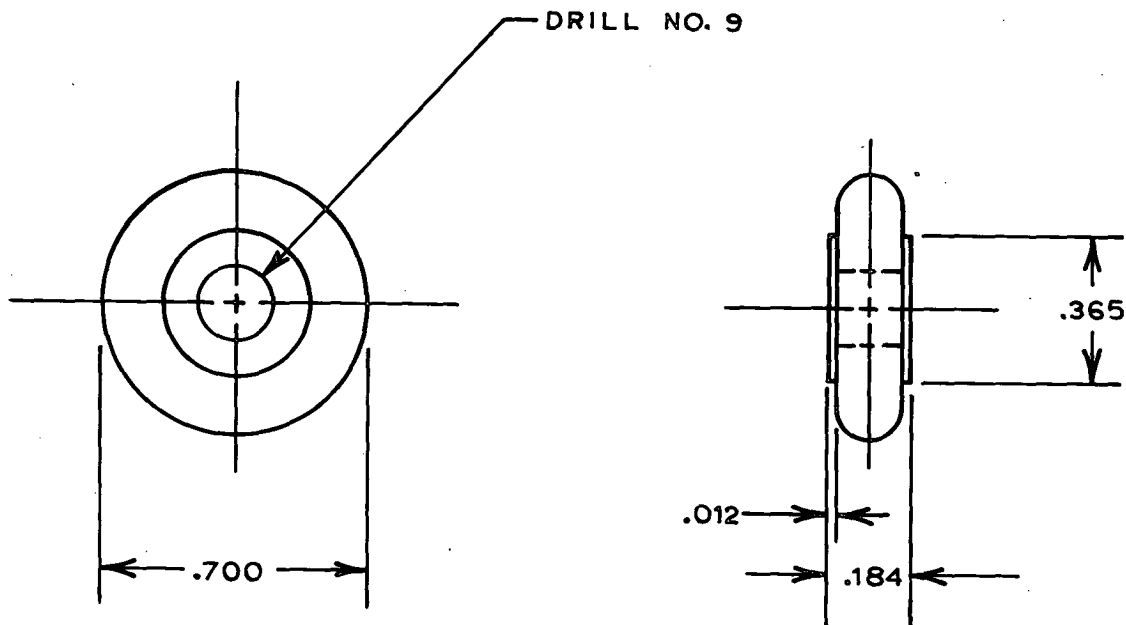
ISSUE	DATE	DESCRIPTION
CHANGE NO.	DATE	DESCRIPTION

APPROVED			ENG	DRAWING NO.
BY	FOR	DATE	RJA	365-9
RJA	PROD	10-4-73	DRAWN BY PLL	
			CHECKED GIM	DATE 9-17-73

CRIMP ROLL

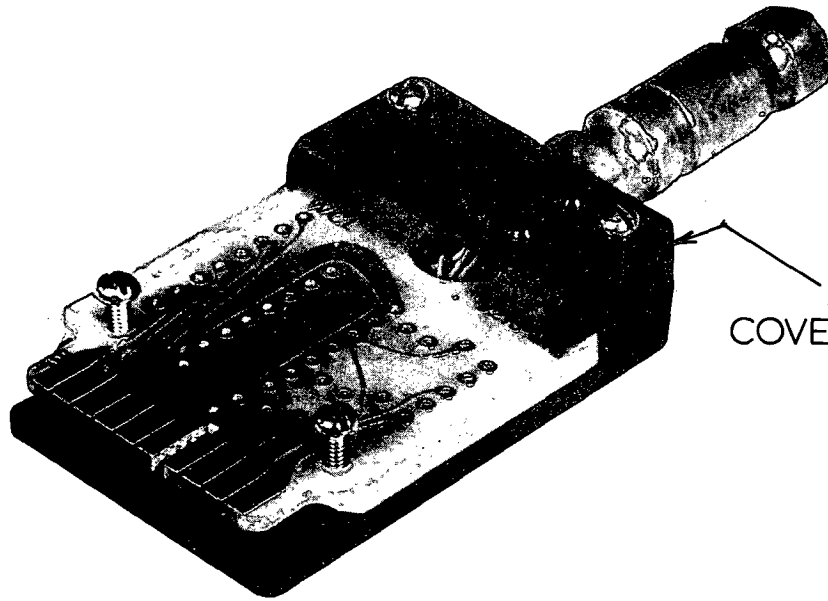
MAT'L: HEAT TREATED AND TEMPERED DRILL ROD

DIMENSIONS $\pm .005$ U.O.N.

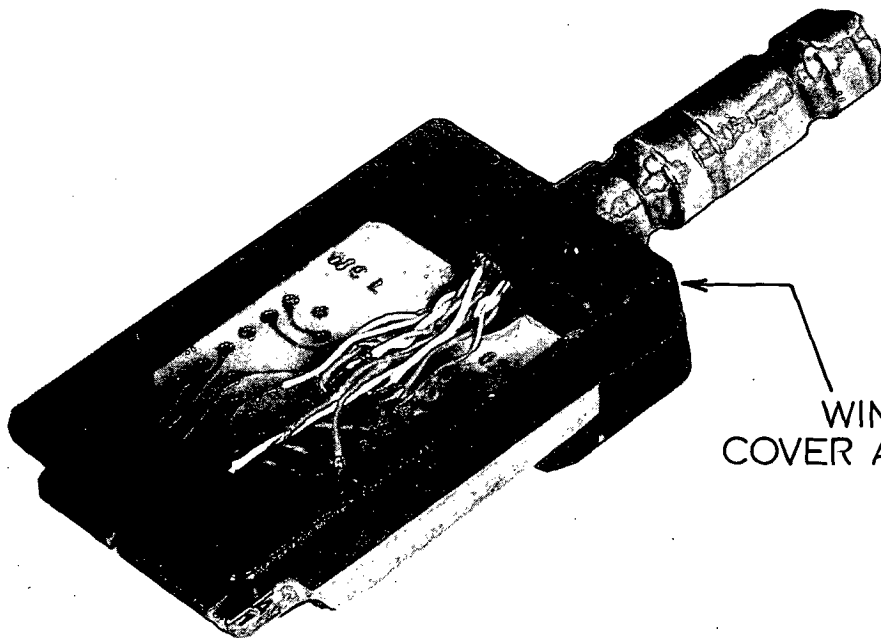


CRIMP ROLL

COMPUTER SYSTEMS LABORATORY WASHINGTON UNIVERSITY ST. LOUIS, MISSOURI			MACROMODULAR PROJECT			
			TITLE SWAGING TOOL			
			APPROVED BY <i>RJA</i> FOR PROD DATE <i>10-1-73</i>			ENG RJA DRAWN BY PLL
ISSUE			CHECKED <i>FM</i>			DATE 9-17-73
CHANGE NO.	DATE	DESCRIPTION				



SHORT HEAD
COVER ASSEMBLY JIG



WINDOW HEAD
COVER ASSEMBLY JIG

COMPUTER SYSTEMS LABORATORY WASHINGTON UNIVERSITY ST. LOUIS, MISSOURI			MACROMODULAR PROJECT			
<div style="display: flex; justify-content: space-between;"> <div> 135 CHANGE NO </div> <div>DATE</div> <div>DESCRIPTION</div> </div>			TITLE WINDOW AND SHORT HEAD COVER ASSEMBLY JIGS			
			APPROVED		ENG	DRAWING NO
			BY	FOR	DATE	
			RJA	PROD	10-4-73	DRAWN BY
			CHECKED	DATE		
			G.M.	9-26-73		

WASHINGTON UNIVERSITY

PEDESTAL AC POWER CABLE

[illegible]

366-1

PARTS LIST

QTY.	C.S.L. DOC.	PART
1	—	RECEPTACLE, AMPHENOL 60-F
1	—	SHELL, AMPHENOL 3-858
1	—	CABLE, BELDEN 14629S (9 ft.) or 17635S (15 ft.)

MACROMODULAR SYSTEMS PROJECT

ASSEMBLY

1. Screw the two halves of an Amphenol shell together and ream the small end to a $17/32$ inch diameter. Then tap the hole with 9/16-12 threads.
2. Strip the black insulation on a Belden cable back one inch. Strip the insulation on each of the three conductors back 0.5 inch.
3. Solder the three cable conductors to an Amphenol receptacle as follows:

Black wire - Pin 1
White wire - Pin 2
Green wire - Pin 3G
4. Mount the shell on the receptacle. Note indexing slot on receptacle.

370

PAGE	TITLE	CHANGE
370-1	TITLE PAGE	C
370-2 and 370-3	INTRODUCTION AND WIRE	C
370-4	CONNECTORS AND WIRE VARIATIONS	
370-5	DATA CABLE HEAD	
370-6	ASTRO 348 PARTS	
370-7	ASSEMBLY SEQUENCE PICTORIAL	
370-8 thru 370-10	ASSEMBLY SEQUENCE	
370-11	TOOLS AND PREPARED CABLE	
370-12	PAIR ISOLATION	
370-13	POSITION OF FERRULE AND CABLE	
370-14	TINE COMPRESSION	
370-15	MATED ASSEMBLY FIXTURE	
370-16	TESTING	
370-17 and 370-18	WIRING LIST	
370-19	OUTER HOUSING	A
370-20	COMPRESSION NUT	A
370-21	TINED FERRULE	A, B
370-22	ASSEMBLY FIXTURE	

[illegible]

ASSEMBLY SPECIFICATION
MACROMODULAR DATA CABLE

I. Introduction

This specification describes a cable and connector assembly which will carry high speed digital data in a modular computer system. This "Data Cable" consists in general of a length of multiconductor, jacketed cable terminated by identical connectors on each end.

II. Cable Stock

The jacketed cable was produced by Brand Rex Division of Akzona Corporation, Willimantic, Connecticut, to meet CSL Specification CAS-5 (Model C Data Cable). The cable is completely described by CAS-5. (Refer to Document 010).

III. Stripping and Crimping

The stripping specification of 0.125--0.150 inches is very critical to the long term reliability of the Data Cable. Failures in early assemblies were traced to cases in which the wire insulation entered the crimp portion of the contact barrel. These failures were position sensitive, and the assemblies were initially able to pass the electrical specification.

The second requirement on strip length is that the insulation shall tuck into the rear of the contact barrel, in order to support the tiny #30 AWG. wire during the assembly operation.

CHG.	E.C.O.	DATE	APPR.
Re-iss	0179	5-13-71	ref

The manufacturer of the data cable assemblies shall demonstrate a technique for wire stripping which will consistently meet the stripping tolerance, and samples shall be supplied to CSL for approval before any production is undertaken. While the manufacturer is free to devise any technique applicable to his particular circumstances, the following comments may prove helpful.

The Clauss Cutlery Company makes a small hand operated stripping tool which gives good results on #30 wire when properly sized. The .014 No-Nik tool consistently strips the insulation without deforming the wire. A small wire stop jig has been designed which can be riveted to the No-Nik tool, and in the hands of a careful operator, the required stripping tolerance has been met.

All wires shall be crimped with acceptable tooling as shown in the tooling chart, or equivalent automatic tooling. The settings of the tools shall be determined by a simple pull test. The wire shall break consistently at, or near the crimp; after noticeable elongation. An optimum crimped termination has 70% of the tensile strength of the wire.

TOOLING CHART

MANUFACTURER	TOOL
BUCHANAN	612596 CRIMP TOOL
BUCHANAN	613381 LOCATOR

CHG.	E.C.D.	DATE	APPR.
C	0277	12-7-72	<i>[Signature]</i>

CONNECTORS AND VARIATIONS

Connectors

The connectors on each of the two ends of the cable are special versions of an Amphenol ASTRO-348 with a 14-37 insert. The entire connector is available under Amphenol part number 348-7011-1 and is shown on the drawing 370-6.

Reference drawings of the connector parts are included here to facilitate the engineering of special purpose cables. The drawings are not intended, but may be used, to manufacture the parts shown.

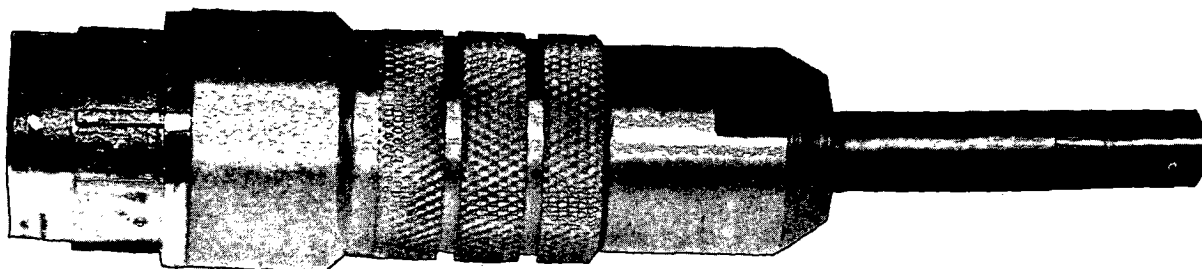
Variations

All cables shall be identical except in length. The length is defined as the measurement from end to end of the cable stock, before stripping and termination. The tolerance on length shall be $\pm 1/2$ inch.

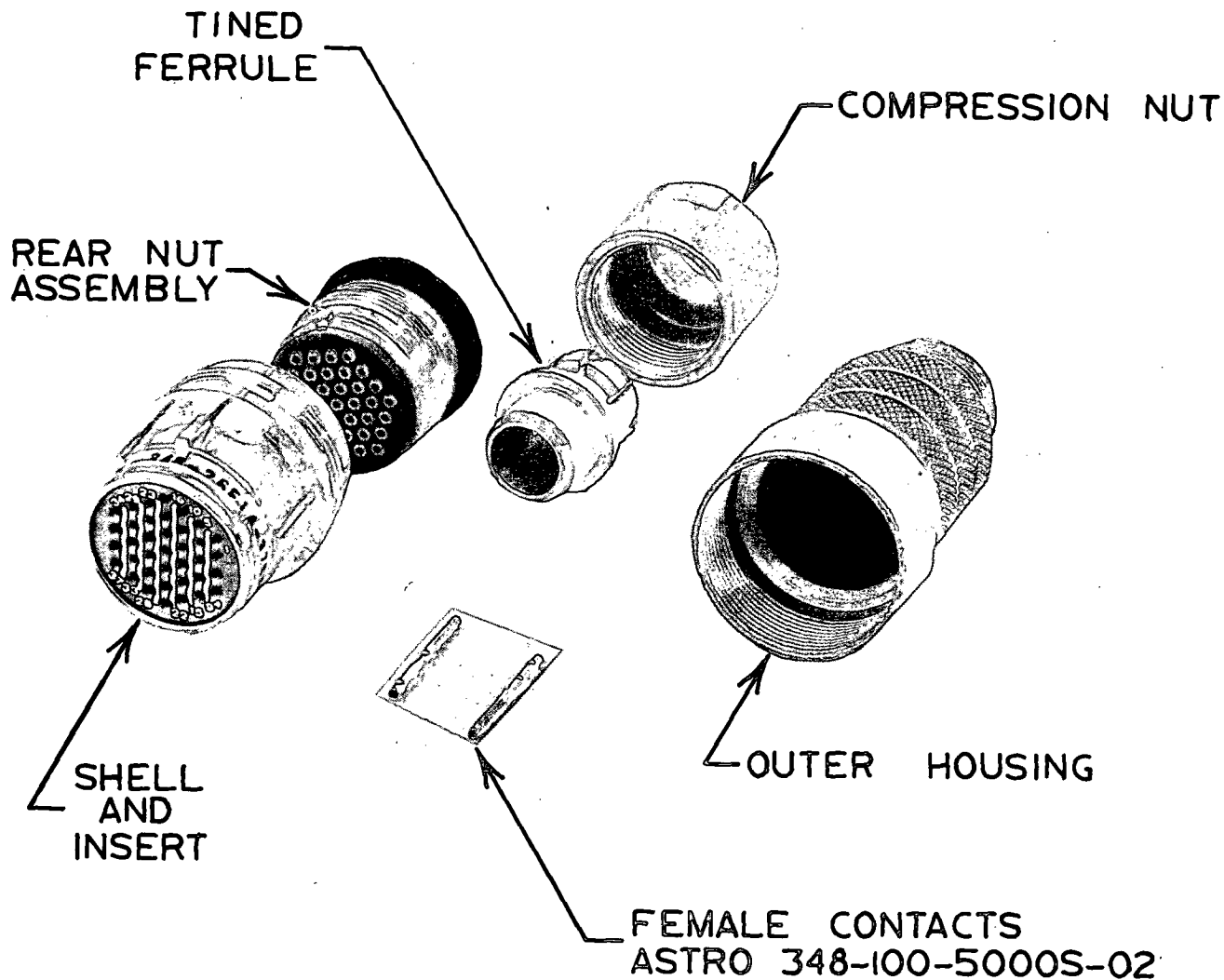
The cables shall be constructed in the following lengths:

- | | |
|--------------|---------------|
| 1. 16 inches | 5. 66 inches |
| 2. 26 inches | 6. 96 inches |
| 3. 36 inches | 7. 126 inches |
| 4. 46 inches | 8. 246 inches |

CHG.	E.C.O.	DATE	APPR.
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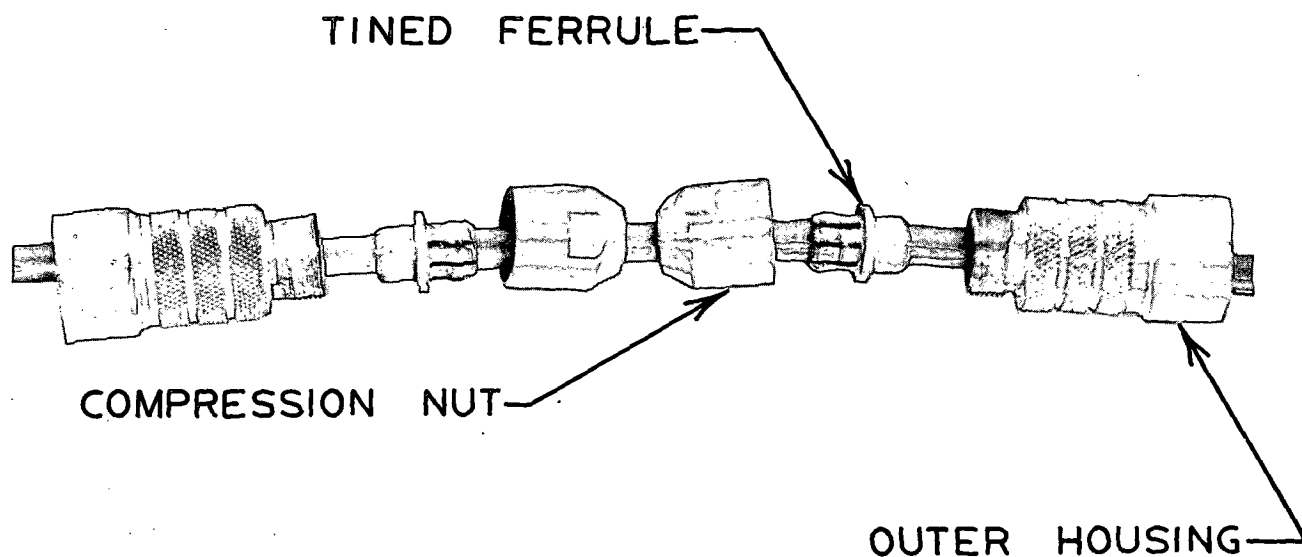


COMPUTER SYSTEMS LABORATORY WASHINGTON UNIVERSITY ST. LOUIS, MISSOURI			MACROMODULAR PROJECT				
			TITLE DATA CABLE HEAD				
			APPROVED			ENG GCJ	DRAWING NO.
			BY GCJ	FOR PROD.	DATE 12-7-70	DRAWN BY DLS	370-5
RE-155	5-13-71	E.C.O. 0179 GCJ				CHECKED GCJ	DATE 12-7-70
CHANGE NO.	DATE	DESCRIPTION					



AMPHENOL ASTRO 348-7011-1

COMPUTER SYSTEMS LABORATORY WASHINGTON UNIVERSITY ST. LOUIS, MISSOURI			MACROMODULAR PROJECT		
			TITLE ASTRO 348 PARTS		
			APPROVED		
			BY <i>gcj</i>	FOR PROD.	DATE 5-13-71
			ENG G CJ		DRAWING NO. 370-6
			DRAWN BY GWP		
			CHECKED <i>gcj</i>		DATE 5-13-71
RE-ISS	5-13-71	E.C.O. 0179 <i>gcj</i>			
CHANGE NO.	DATE	DESCRIPTION			



COMPUTER SYSTEMS LABORATORY
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MACROMODULAR PROJECT

TITLE

ASSEMBLY SEQUENCE
PICTORIAL

			<table border="1"> <tr> <th colspan="3">APPROVED</th> <td data-bbox="1169 1831 1326 1888">ENG GCJ</td> <td data-bbox="1326 1831 1511 1888" rowspan="2">DRAWING NO. 370-7</td> </tr> <tr> <td>BY</td> <td>FOR</td> <td>DATE</td> <td data-bbox="1169 1888 1326 1945">DRAWN BY GWP</td> </tr> </table>	APPROVED			ENG GCJ	DRAWING NO. 370-7	BY	FOR	DATE	DRAWN BY GWP
APPROVED			ENG GCJ	DRAWING NO. 370-7								
BY	FOR	DATE	DRAWN BY GWP									
RE-ISS	5-13-71	E.C.O. 0179 <i>ref</i>	<table border="1"> <tr> <td><i>GCJ</i></td> <td>PROD.</td> <td>5-13-71</td> <td data-bbox="1169 1945 1326 2009" rowspan="2">CHECKED <i>ref</i></td> <td data-bbox="1326 1945 1511 2009" rowspan="2">DATE 5-13-71</td> </tr> <tr> <td></td> <td></td> <td></td> </tr> </table>	<i>GCJ</i>	PROD.	5-13-71	CHECKED <i>ref</i>	DATE 5-13-71				
<i>GCJ</i>	PROD.	5-13-71	CHECKED <i>ref</i>	DATE 5-13-71								
CHANGE NO.	DATE	DESCRIPTION										

Assembly Sequence

1. Cut cable to length as defined above.
2. Slide on 2 Compression Nuts.
3. Slide on 2 Tined Ferrules. Spread tines if necessary to prevent scoring of outer jacket. Be tender, the tines are easily broken.
4. Slide on 2 Outer Housings. Drawing 370-7 shows assembly at this stage.

Do These Operations To Both Ends of Cable

5. Cut back outer jacket 2 1/4 inches.
6. Cut away all but 1/2 inch of shield.
7. Comb out shield, using a dull instrument such as a lead pencil, fold back and tape.
8. Remove all but 1/2 inch of black polyethylene inner jacket.
9. Remove mylar tape. Dwg. 370-11.
10. Carefully isolate individual twisted pairs. Dwg. 370-12.
11. Untwist pairs to obtain 1 1/2 inch of free wire for stripping.
12. Trim ends of wires 1/8 inch to eliminate damage from cable cutting operation.
13. Strip individual conductors (.125--.150 inches). (This strip length is critical.)

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14. Crimp contacts onto wires. Inspect to assure that all wires are visible in the crimp inspection port.
15. Insert contacts into rear nut-retention disc assembly per wiring list. Place uncrimped contact into location 5.
16. Place completed disc assembly into modified ASTRO-348 connector Shell.
17. Complete assembly by screwing rear nut into the Connector Shell--tighten until nut bottoms with channellock pliers.
18. After the assembly of the rear nut, bend the two bare wires into the recess between the rear nut and the Connector Shell. Solder the wires. Take care that the wires are dressed as close as possible to the outer diameter of the nut.
19. Slide Outer Housing forward, and screw onto Connector Shells and tighten with special thin wrench.
20. Remove tape from shield wire.

Final Operations - do to each end in sequence.

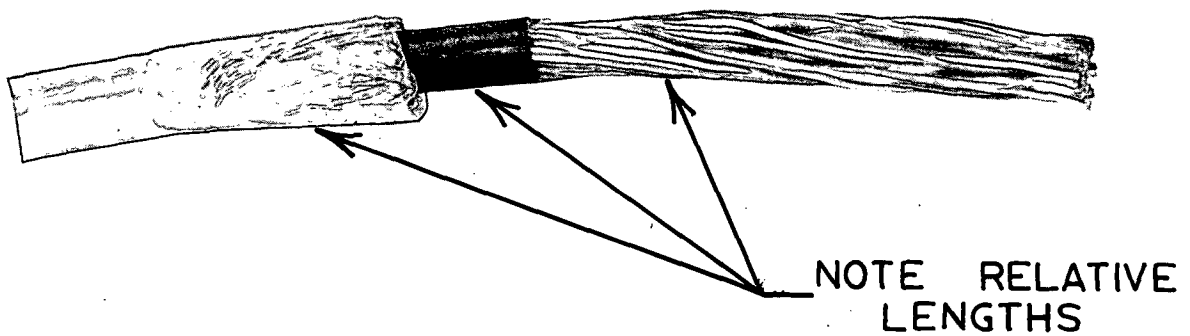
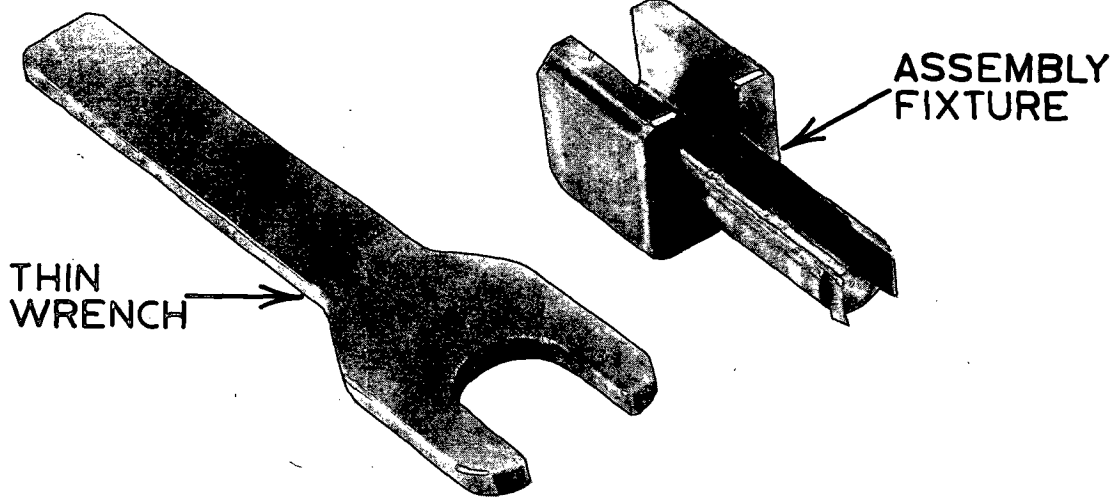
Slide the Tined Ferrule forward (Picture 370-13) until the front end is flush with the cut surface of the cable jacket. Using a preset pair of VISE-GRIP pliers, compress the side tines carefully. - Picture 370-14. Move the Compression Nut forward and insert Assembly Fixture into Nut. Mate Fixture with slots in Ferrule. Use finger pressure or pliers to achieve mating.

Fold shield wires back symmetrically, and trim wires short of shoulder. Push Ferrule and Fixture into contact with the Outer

Housing. Apply axial pressure to the assembly, and support with a vise or special fixture - Picture 370-15.

Move Compression Nut along barrel of Assembly Fixture and tighten nut with wrench.

The Assembly Fixture must remain mated until the Compression Nut is fully tightened. The Ferrule must not be allowed to rotate at any time during assembly. If the Fixture does slip - more axial force must be applied in the preceding assembly step.



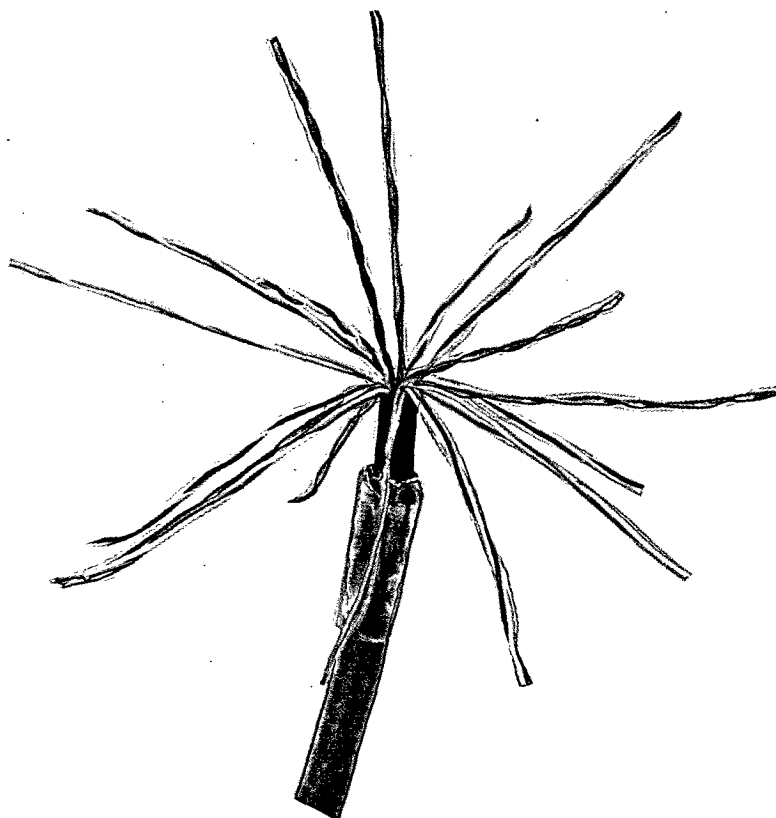
COMPUTER SYSTEMS LABORATORY
WASHINGTON UNIVERSITY
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MACROMODULAR PROJECT

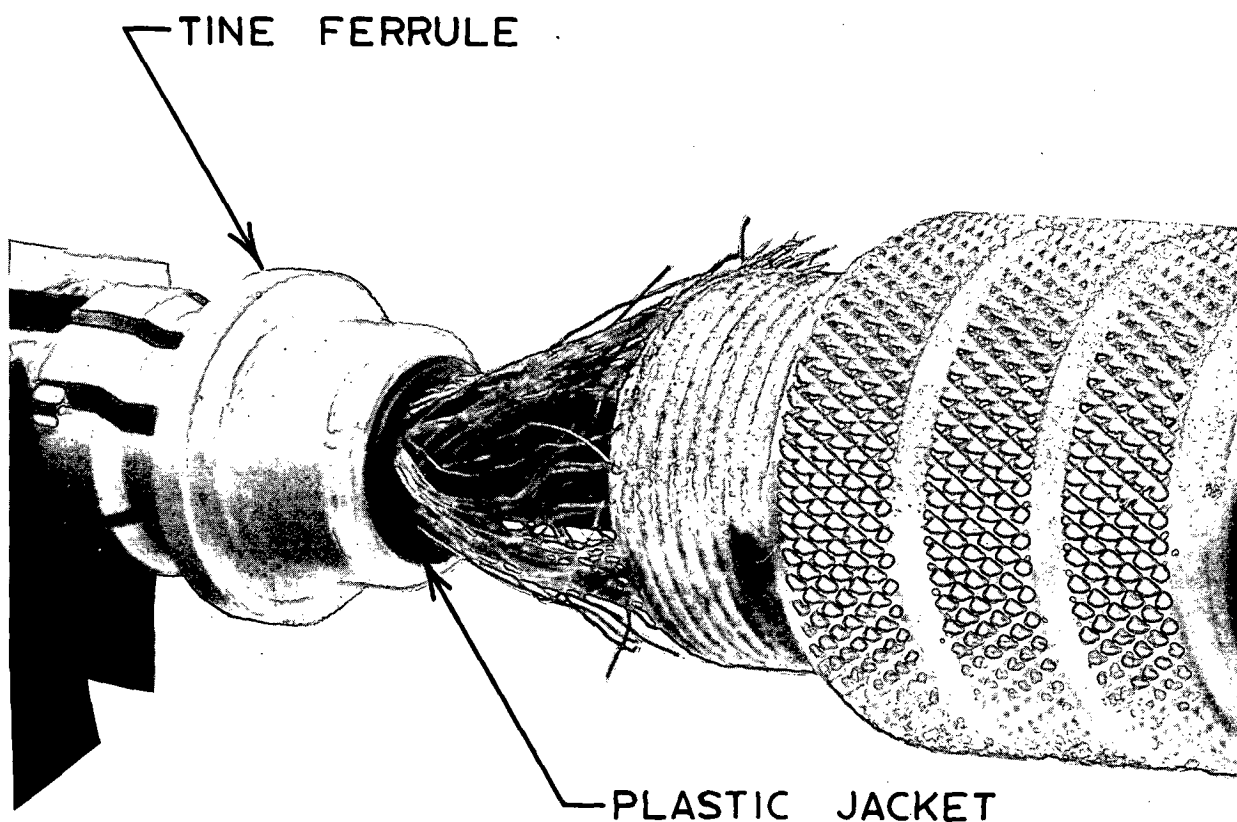
TITLE

TOOLS AND PREPARED CABLE

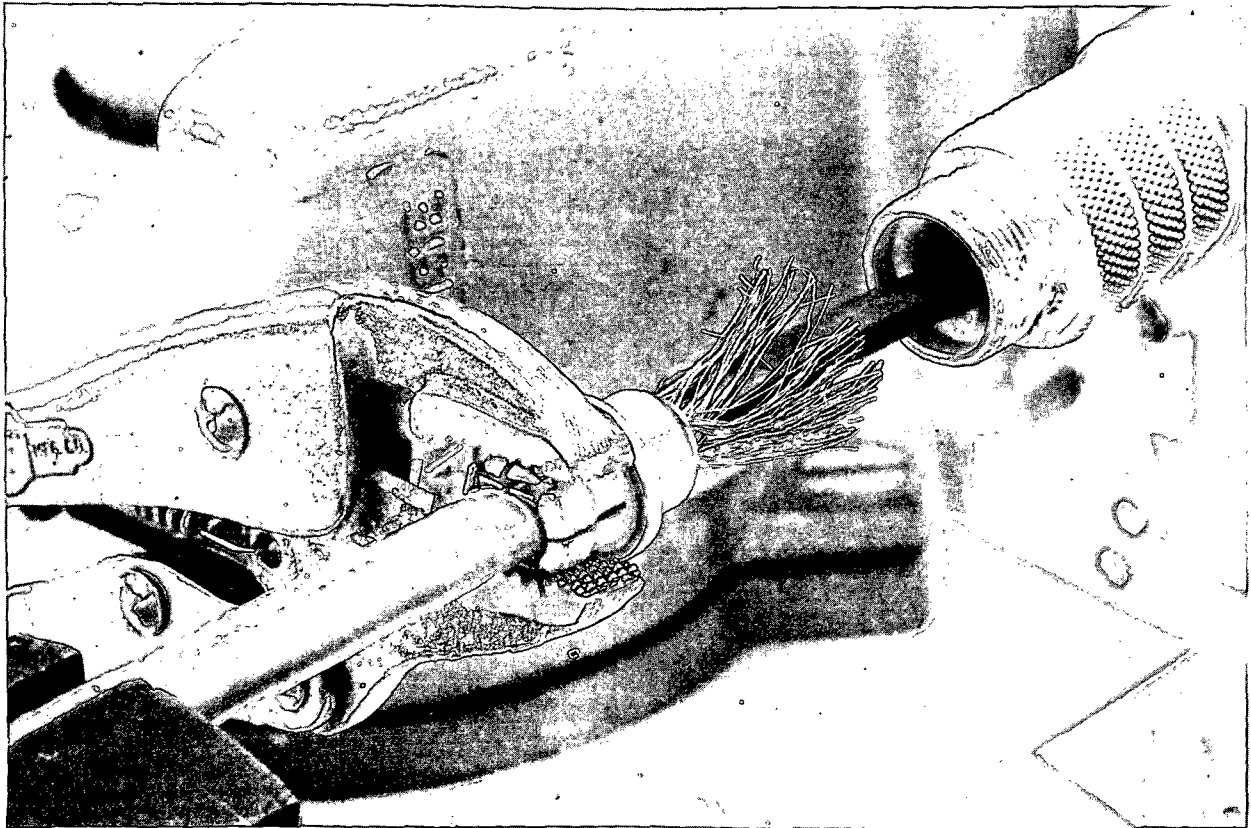
				APPROVED		ENG GCJ	DRAWING NO.
RE-ISS	5-13-71	E.C.O. 0179 <i>gcj</i>		BY <i>gcj</i>	FOR PROD.	DATE 5-13-71	370-11
CHANGE NO.	DATE	DESCRIPTION		CHECKED <i>gcj</i>		DATE 5-13-71	



COMPUTER SYSTEMS LABORATORY WASHINGTON UNIVERSITY ST. LOUIS, MISSOURI			MACROMODULAR PROJECT				
			TITLE PAIR ISOLATION				
			APPROVED			ENG GCJ	DRAWING NO.
			BY <i>gcj</i>	FOR PROD.	DATE 5-13-71	DRAWN BY GWP	370-12
RE-ISS	5-13-71	E.C.O. 0179 <i>gcj</i>				CHECKED <i>gcj</i>	DATE 5-13-71
CHANGE NO.	DATE	DESCRIPTION					



COMPUTER SYSTEMS LABORATORY WASHINGTON UNIVERSITY ST. LOUIS, MISSOURI			MACROMODULAR PROJECT		
			TITLE POSITION OF FERRULE AND CABLE		
			APPROVED		ENG GCJ
			BY GCJ	FOR PROD.	DATE 5-13-71
					DRAWN BY GWP
					CHECKED GCJ
RE-ISS	5-13-71	E.C.O. 0179 GCJ			DRAWING NO. 370-13
CHANGE NO.	DATE	DESCRIPTION			DATE 5-13-71



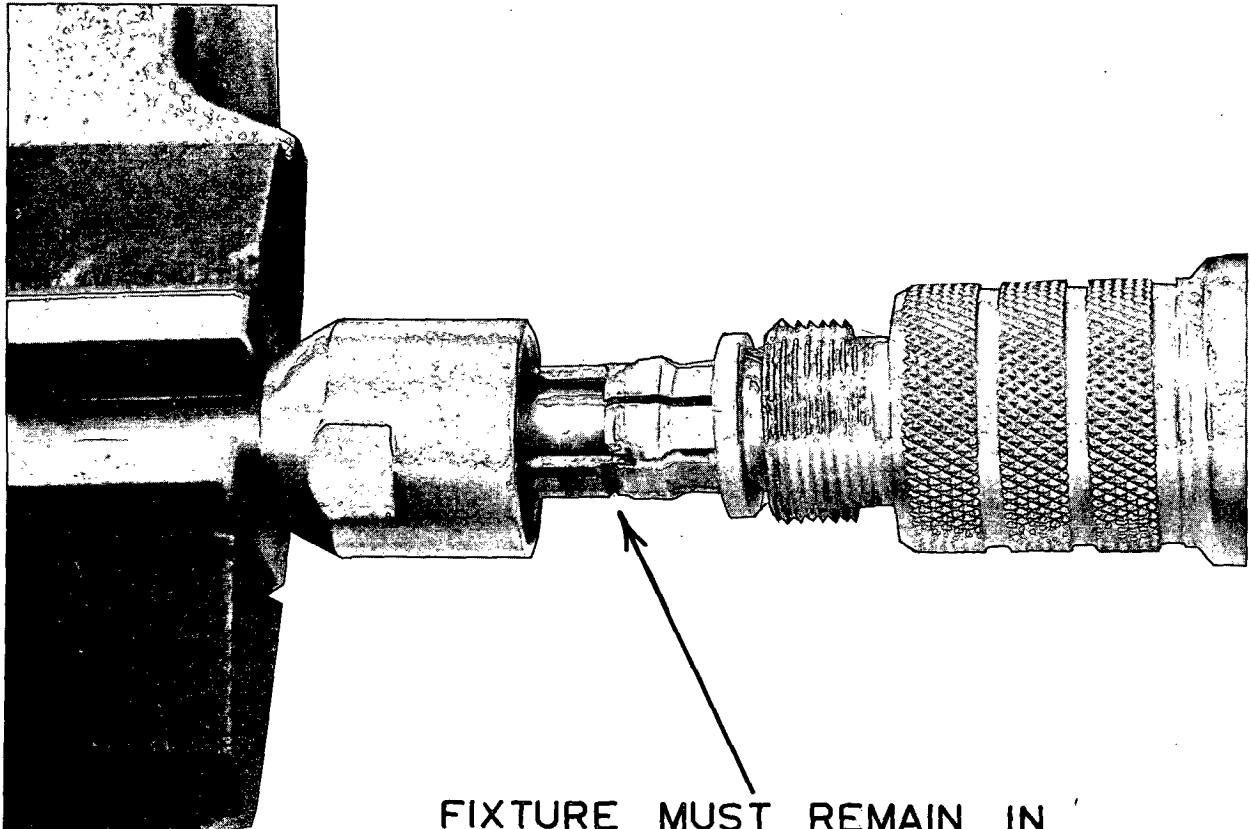
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ST. LOUIS, MISSOURI

MACROMODULAR PROJECT

TITLE

TINE COMPRESSION

			APPROVED			ENG	DRAWING NO.
			BY	FOR	DATE	GCJ	370-14
			GCJ	PROD.	5-13-71	DRAWN BY GWP	
CHANGE NO.	DATE	DESCRIPTION				CHECKED	DATE
RE-1SS	5-13-71	E.C.O. 0179 <i>gcj</i>				<i>gcj</i>	5-13-71



FIXTURE MUST REMAIN IN
CONTACT WITH FERRULE
UNTIL NUT IS FULLY
TIGHTENED.

COMPUTER SYSTEMS LABORATORY WASHINGTON UNIVERSITY ST. LOUIS, MISSOURI			MACROMODULAR PROJECT				
			TITLE MATED ASSEMBLY FIXTURE				
			APPROVED			ENG GCJ	DRAWING NO.
			BY gcj	FOR PROD.	DATE 5-13-71	DRAWN BY GWP	370-15
CHANGE NO.	DATE	DESCRIPTION				CHECKED gcj	DATE 5-13-71
RE-155	5-13-71	E.C.O. 0179 gcj					

Testing

The cable shall be tested for continuity and shorts as follows:

1. Each pin shall be connected to the pin of the same number on the opposite end with a resistance of less than one ohm.
Exception--Pin 5 shall be open.
2. Each pin shall be isolated from all other pins by a resistance greater than one megohm.
3. The Outer Housing shall be connected to pins 29 and 22 by a resistance of less than 0.5 ohm.

CHG.	E.C.O.	DATE	APPR.
Re-iss	0179	5-13-71	<i>scj</i>

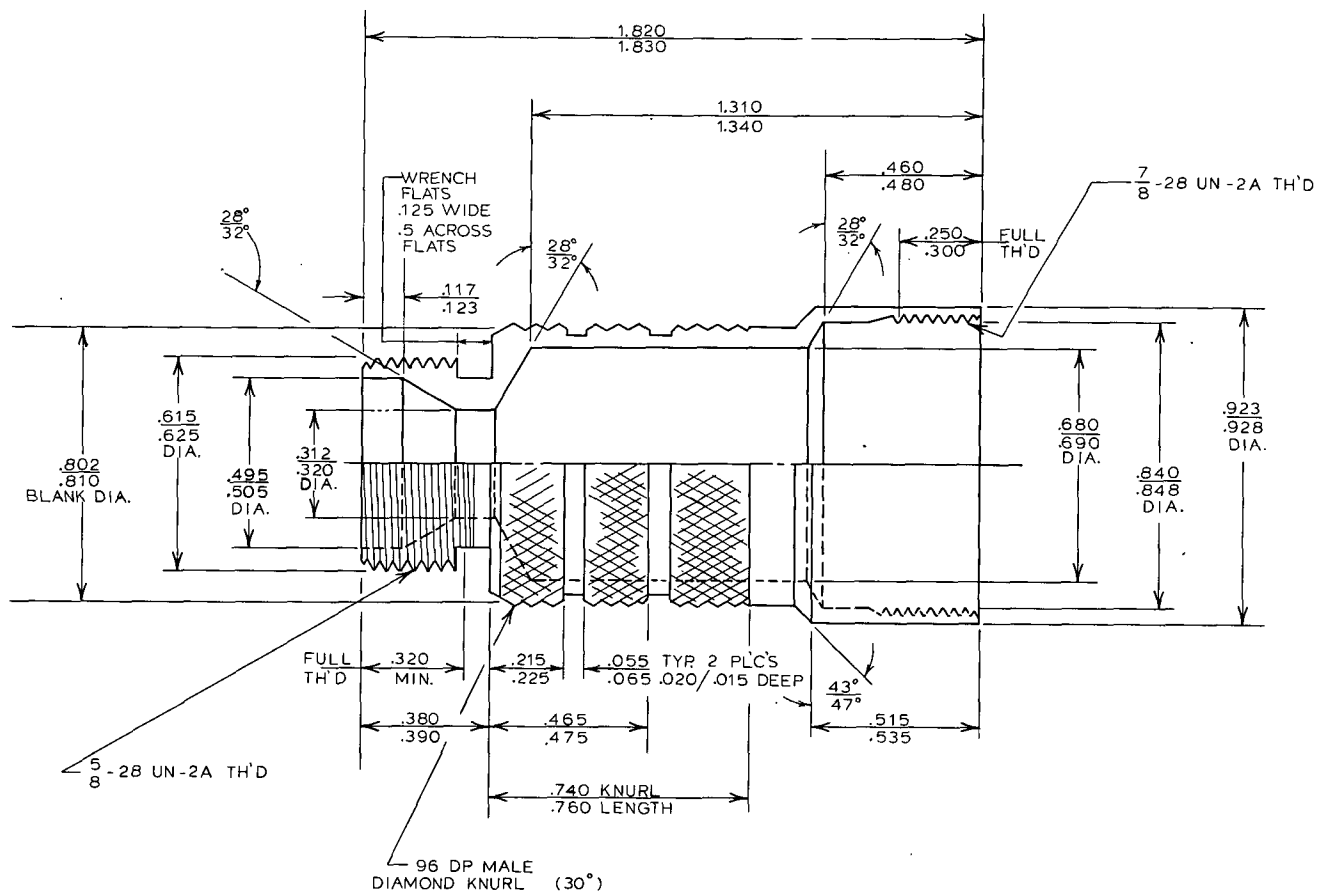
DCBP,2 LN=71

```

31      BIT 1 L      SLATE
>>>>>>>>>>>>>>>
32      BIT 2 H      RED
33      BIT 2 L      BLUE
>>>>>>>>>>>>>>>
34      SPARE 5      WHITE
35      SPARE 6      BLUE
>>>>>>>>>>>>>>>
36      BIT 0 H      YELLOW
37      BIT 0 L      ORANGE
>>>>>>>>>>>>>>>
END OF LIST

```

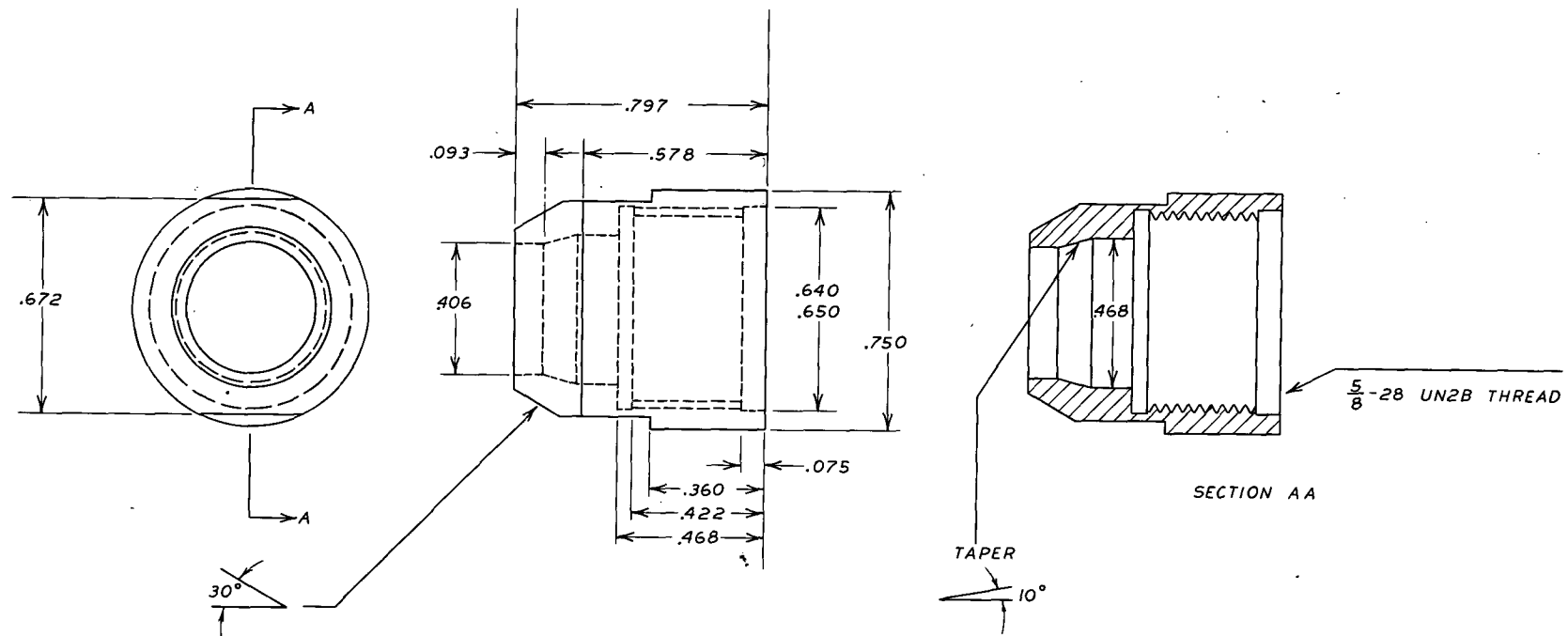
[DCBP
[GERALD C JOHNS
[8 DECEMBER 1970



MAT'L: ALUM 6061-T6

PARTS SHALL BE FINISHED AS FOLLOWS:
CADMIUM PLATE (0.0002-0.0004 INCHES THICK)
OVER NICKEL PLATE (0.0001-0.0002 INCHES THICK)
FOLLOWED BY CLEAR CHROMATE CONVERSION.

CHANGE NO.	DATE	DESCRIPTION
A	5-28-71	E.C.O. 0193 <i>gcj</i>
RE-ISS	5-13-71	E.C.O. 0179 <i>gcj</i>
COMPUTER SYSTEMS LABORATORY		
WASHINGTON UNIVERSITY		
ST. LOUIS, MISSOURI		
MACROMODULAR PROJECT		
TITLE		
OUTER HOUSING		
APPROVED	ENG.	DRAWING NO.
BY <i>gcj</i>	FOR <i>gcj</i>	370-19
DATE <i>11-1-70</i>	CHECKED <i>gcj</i>	DATE <i>10-27-70</i>



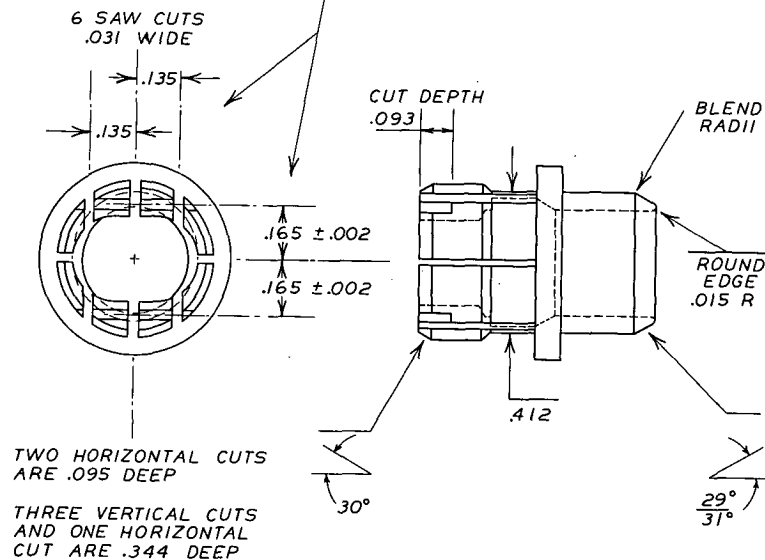
DEBURR BREAK ALL CORNERS .010
 DIMENSIONS: $\pm .005$ U.O.N.
 MAT'L: 6061-T6 ALUM

TAPERS $\pm 2^\circ$

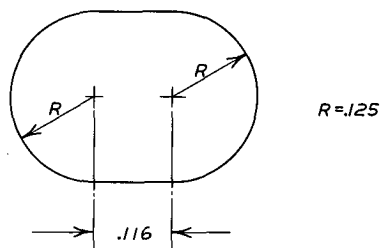
PARTS SHALL BE FINISHED AS FOLLOWS:
 CADMIUM PLATE (0.0002-0.0004 INCHES THICK)
 OVER NICKEL PLATE (0.0001-0.0002 INCHES THICK)
 FOLLOWED BY CLEAR CHROMATE CONVERSION.

CHANGE NO.	DATE	DESCRIPTION
A	5-28-71	E.C.O. 0193 <i>gcz</i>
RE-155	5-13-71	E.C.O. 0179 <i>gcz</i>
COMPUTER SYSTEMS LABORATORY WASHINGTON UNIVERSITY ST. LOUIS, MISSOURI		
MACROMODULAR PROJECT		
TITLE COMPRESSION NUT		
BY	APPROVED	ENG.
<i>gcz</i>	DATE	<i>GCJ</i>
PROJ	11-1-70	DRAWN BY
		<i>PLL</i>
CHECKED	DATE	
<i>gcz</i>	9-15-70	DRAWING NO.
		370-20

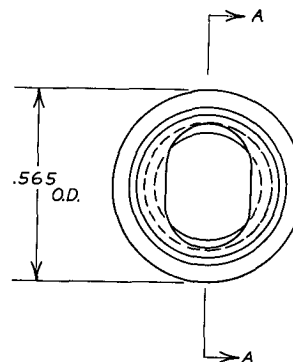
DIMENSIONS ARE FROM
CENTER OF PART TO
CENTERLINE OF CUT



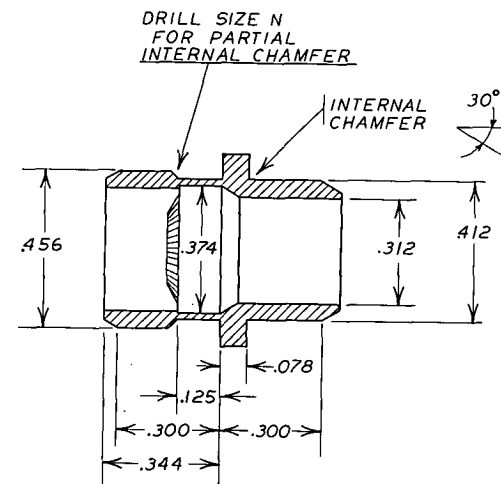
OVAL DETAIL



REAR DETAIL
BEFORE SLOTTING



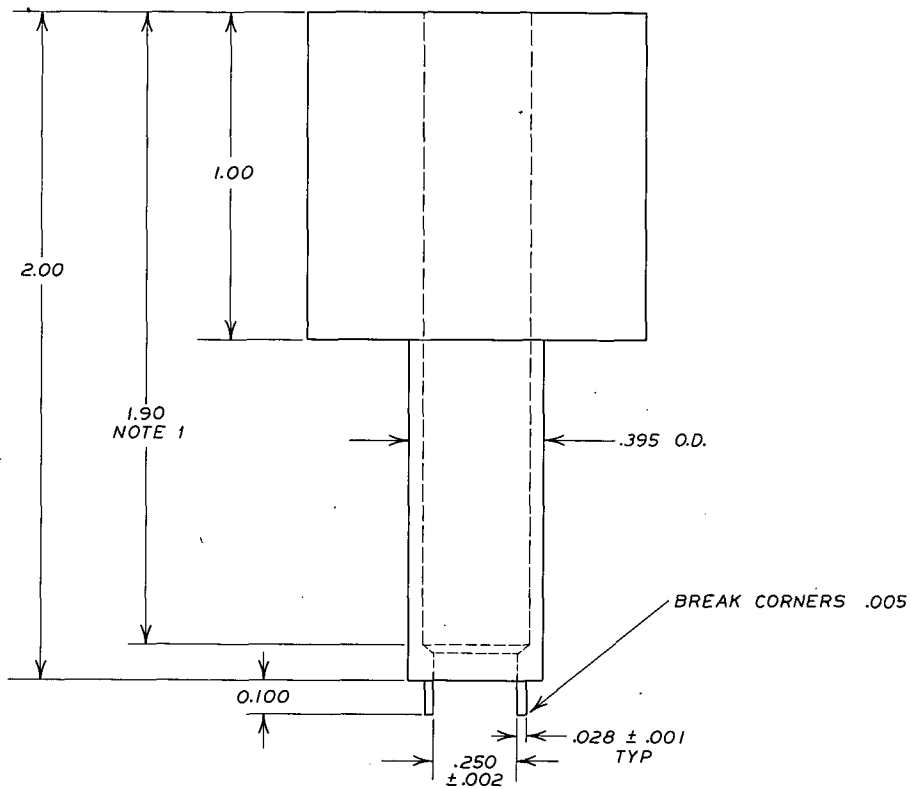
SECTION AA



DEBURR, BREAK EDGES 0.010
DIMENSIONS: ± .005 U.O.N.
ALL ANGLES: ± 2 DEGREES
EXCEPT AS NOTED
MATERIAL: 6061-T6 ALUM

PARTS SHALL BE FINISHED AS FOLLOWS:
CADMIUM PLATE (0.0002-0.0004 INCHES THICK)
OVER NICKEL PLATE (0.0001-0.0002 INCHES THICK)
FOLLOWED BY CLEAR CHROMATE CONVERSION.

B	1-6-72	E.C.O. 0244	201
A	5-28-71	E.C.O. 0193	201
RE-155	5-12-71	E.C.O. 0179	201
CHANGE NO.	DATE	DESCRIPTION	
COMPUTER SYSTEMS LABORATORY			
WASHINGTON UNIVERSITY			
ST. LOUIS, MISSOURI			
MACROMODULAR PROJECT			
TITLE			
TINED FERRULE			
APPROVED	FOR	DATE	ENG.
BY	FOR	DATE	ENG.
201	PROP	5-17-71	201
DRAWN BY			DRAWING NO.
PLL			370-21
CHECKED			DATE
201			5-14-71



NOTE 1: DRILL .312 TO DEPTH SHOWN, THEN OPEN SLOT IN BLOCK.

NOTE 2: ROUND THESE CORNERS (4 INSIDE) APPROX .015 R

MAT'L: 1 INCH SQUARE BAR TOOL STEEL

DIMENSIONS ± .005 U.O.N.

RE-155-12-71		E.C.O. 0179		907
CHANGE NO.	DATE	DESCRIPTION		
COMPUTER SYSTEMS LABORATORY				
WASHINGTON UNIVERSITY				
ST. LOUIS, MISSOURI				
MACROMODULAR PROJECT				
TITLE				
ASSEMBLY FIXTURE				
APPROVED		ENG.		DRAWING NO.
BY	FOR	DATE	GCJ	370-22
907	PROO.	5-17-71	DRAWN BY	
			PLL	
			CHECKED	DATE
			907	5-14-71

UNCLASSIFIED
Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) Computer Systems Laboratory Washington University St. Louis, MO		2a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED	
3. REPORT TITLE CABLES		2b. GROUP	
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Final Report 4/1/65 through 12/31/73			
5. AUTHOR(S) (First name, middle initial, last name) Gerald C. Johns, Editor			
6. REPORT DATE February, 1974		7a. TOTAL NO. OF PAGES 74	7b. NO. OF REFS
8a. CONTRACT OR GRANT NO. DOD (ARPA) Contract SD-302		9a. ORIGINATOR'S REPORT NUMBER(S) Volume XI of Part 2	
b. PROJECT NO. ARPA Project Code No. 655		9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) Technical Report No. 40	
c.			
d.			
10. DISTRIBUTION STATEMENT Distribution of this document is unlimited.			
11. SUPPLEMENTARY NOTES		12. SPONSORING MILITARY ACTIVITY ARPA - Information Processing Techniques, Washington, D.C.	
13. ABSTRACT Manufacturing information for the construction and testing of macro-modular cables is given. Included are the DATA CABLE, CONTROL CABLE, PEDFSTAL DAISY CHAIN CABLE, and FUNCTION CALLER CABLE.			

DD FORM 1473

REPLACES DD FORM 1473, 1 JAN 64, WHICH IS OBSOLETE FOR ARMY USE.

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14.	KEY WORDS	LINK A		LINK B		LINK C	
		ROLE	WT	ROLE	WT	ROLE	WT
	Macromodule Data Cable						
	Macromodule Control Cable						
	Macromodule Daisy Chain Cable						
	Macromodule Function Call						
	Macromodule Cables						

