10/2/85

There are four VLBA Standard Interface packaging problems:

1) MODULE/BIN INTERFACE ---- Some blind-mating connector must carry the bus signals through the module/bin interface on controlled modules. The connector should have either coaxial or twin-ax (two conductor surroundedby a shield) contacts, depending upon the bus distribution wiring.

I propose to use the AMP 16 position mixed connector which has 4 contact cavities used for the AMP Twin Standard Coaxicon or Standard Coaxicon connectors and 12 cavities for the Type II contacts which we have used on the VLA project for years. I propose these Twin Standard Coaxicon contacts because they are natural choices for shielded balanced differential signals. I have done an extensive catalog search for a suitable connector and have not found any better choices for the reasons outlined below. See the attached AMP data sheets. (I don't own any AMP stock)

This connector is externally identical to the AMP 34 pin connector in every external dimension and would not require any adaption of the module dimensions or use of different pins and tooling for the non-bus signal pins. Clearly, this connector block would not impose any significant packaging constraints on the module or bin dimensions. The Twin Standard Coaxicon contacts are polarized by a "D" shaped cross-section and oriented in the block by the engagement of one of the 6 retention spring leaves in a longitudinal groove in the cavity, (a potential confusion factor because there are 6 possible orientations). See the attached data sheets for these blocks and contacts.

A new crimping tool would be required for these Twin Standard Coaxicon contacts. (~$300) The termination of these contacts is a careful, labor-intensive job but an easily-learned technique.

I have not used the Twin Standard or Standard Coaxicon contacts and connector blocks but I think that they would be suitable. The only reservation I have about the Twin Standard Coaxicon is that the illustrations on the data sheets do not show much taper on the ends of the contact pins but the contact sockets do have bell-shaped mouths. The catalog photographs show a taper on the pins but this is not quantified; we need numbers. The amount of contact "float" in the block cavities and self-alignment of the contacts are serious concerns in the VLBA blind-mating module/bin interface. I have requested some sample blocks, contacts and detailed drawings of the blocks and contacts to evaluate the blind/mating alignment concern. I hope to have these samples and drawings within a week. I have a crimping tool that Benno Rahrer bought in 1974. Until this evaluation is made I suggest that this choice be considered tentative until this concern is checked out. The blocks are cheap (~$1.50) but the contacts are expensive (~about $10.00 for the contact, ferrule, retention spring and alignment bushing); the costs of a Miniature Coaxicon contact (standard at the VLA) are about $5.00/contact. See the attached table of AMP Coaxicon Connector costs.

Possible alternate Twin Standard Coaxicon connector blocks are the 10 position and 12 position blocks (see attached data sheets) but they are not appealing for this rather unique bus signal function and are too large to be used in conjunction with other connectors on the rear of a module.

AMP has manufactured these Coaxicon contacts and blocks for about 20 years and says they expect to continue to do so as they are a steady sales (but not high volume) item.

2) BUS SIGNAL DISTRIBUTION ALONG BINS --- The M&C bus signals must be distributed along the rear of the bins and potentially any module position of the 12 could be a tap point; there could be as many as 12 signal taps/bin although this is unlikely.

Ideally, one would like to find some commercially available parts to do this function. After an extensive search through connector and connection catalogs I found only one suitable candidate for shielded differential commoning hardware; again in the AMP Twin Standard Coaxicon family. They make a 10 position Twin Standard "T" block but have recently discontinued the manufacture of the "T" contact vital for this function (strange because they still sell the blocks which are unique to the "T" function). There are commoning strips which one could buy but they are for straight wiring applications and do not have any shielding provisions. None of these seemed at all suitable; they all require some sort of a fabricated metal shielding box with twin-ax connectors.

Unless you know of some candidate hareware I am forced to conclude that we must fabricate a distribution box for these signals. The box should be compact, run length-wise along the rear of the bin and not block access to connectors or be in the way of semi-rigid runs. The attached sketches depicts an approach which uses a standard aluminum extrusion made into a box by adding end plugs and a split cover. A printed circuit board with bus signal tracks would run length-wise and 0.025" square post headers would provide a bus pick-off connection for crimp-pin cable connectors at locations which require a bus connection. The pick-off cable would pass through oval holes in the split cover. Connections on each end of the box would feed the signal in and out to the next bin. A roughly-to-scale sketch depicts this box on the rear of the bin. I have not determined the costs of this approach but the connectors I considered were inexpensive.

I am not wildly enthusiastic about this approach; I don't like to machine parts if it can be avoided.

A second approach, (which I prefer) would again be a shielded box fabricated from an aluminum extrusion with a single piece cover and a printed circuit board for bus wiring down the board.

The box would be similar to that depicted above but could be shallower and narrower. A twin-ax BNC printed circuit board connector would be soldered to the board and project through a hole in the cover. A candidate connector is the AMP # 330873 which costs $6.15 in 1000 quantities. This connector has a hermaphrodite physique so that signal polarity is preserved. At locations where it is necessary to tap onto the bus, two short jumper cables would connect to the Coaxicon block and would use the AMP #2-329944-3 plug which costs $4.01 each. The inevitable AMP $313.88 crimping tool would be used to terminate the twin-ax to the plug. Feed into and out of the box would be via identical connectors at each end of the box. Alternate sources of similar connectors are probably available from Kings or Amphenol; I have not checked the catalogs for this type of BNC. I believe that the extrusion box could be fabricated for about $50.00 to $75.00, the PC board could cost $20.00 so that the parts costs would be about $250/bin. I think that a box like this could be wired and assembled in about a half hour. Consider the fabrication cost as priliminary.

The bus signal distribution from bin to bin would be by short runs of twin-ax cable. The full distribution from computer to clusters of racks in the various rooms of the station and antenna still needs to be worked out.

3) THE USE IF IDC CONNECTORS ON THE STANDARD INTERFACE BOARD -- The use of Flat Strip IDC (Insulation Displacement Connectors) connectors has non-trivial implications entirely aside from the labor required to change existing artwork.

The use of IDC connectors have the general considerations:

a) Signal use only, contacts are typically rated at 1 amp but no one ever uses them for power distribution. There are flat strip cables with larger size wires but there are no cables which offer a mixture of large and small wires in the same cable. Cables that are suitable for power distribution would be unduly bulky for signal runs.

b) They are used almost exclusively for carrying a set of signals from one place to another or to bus (bridge) a set of siganls along the tops of pc boards. In this use they are very handy and the termination is a one-motion process so that one can quickly build a cable. One seldom if ever sees these flat strip cables split out into multiple, dispersed termination location chassis harnesses. Zipping out discrete wires to terminate on non-IDC connectors is difficult, clumsy and half the time and convenience of the IDC approach is lost in these terminations.

c) Shielded IDC cables are stiff, have 10 or more conductors, are very wide and provisions for terminating the shield are kludgy. With all the concern for RFI that I have heard I believe that it would be short-sighted to rule out the possiblilty of running the bus signal wires to the board as shielded wires. See the 3M shielded flat strip cable data sheet which shows the drain wires arranged so that they cannot be terminated by the usual compression of the connector top cap to force the drain wire into the contact fork, there is no fork available and they are located so that it is impossible to do so; one must cut the sheath and fish out the drain wire and crimp a ground lug or similar connector onto the wire so that the ground shield termination is separate from the connector. This is terrible.

Some ground-plane flat-strip cables do enable one to force the drain wire into an available contact fork but a ground- plane cable would not provide the required RFI shielding.

IDC connectors can only be installed at discrete intervals (typically 18") along twisted pair cables because the wire lay is not sufficiently uniform in the twisting region to produce jointly occurring flats across all the pairs so that contact forks properly engage the wires and maintain the proper signal polarity.

d) IDC connectors can only be used once, the forks are deformed by the crimping operation so that if there is a bad termination or something is wrong you must snip off a short piece of cable and use a new connector.

e) The terminations by the IDC technique are tenuous at best and the cables are fragile. A strain relief is vital; we have a Dolch Logic Analyzer which uses non-strain relief IDC connectors on clips that clip onto microprocessor chips. Flexure-induced failures of the terminations are a constant problem with this fine instrument. Some manufacturers brag about the spring-iness of their contact forks, others use dual forks to improve reliability. 3M pioneered these cables and connectors and probably has more experience in the design of the this stuff than anybody but they sell a little ZOT box to test flat strip cables; they would not offer these for sale if they weren't needed. See the attached ZOT box data sheet.

f) It is impossible to visually inspect the termination of an assembled IDC-termination connector; you can only hope that it's OK and test for shorts, opens and termination resistance.

f) Wide flat strip cables are clumsy to compactly dress in a crowded module and the required folds etc will waste a lot of space. Electronic units which use flat strip cables are always designed to deal with folding etc and there is usually a lot of space available to fold and dress the cables. Under the proper conditions they can be very convenient for cabling.

g) Wide flat strip cables are less reliable than narrow ones; I am looking at a 60 wire, .050 pitch cable with strain relief as I write this note. There is a very noticeable upward bowing of the center of the connector cap; the terminations in the middle of the connector are more tenuous than the end terminations because the middle wires can work loose since there is less force on these wires to keep them in the forks. I suggest that you carefully look for this effect in wide flat strip cable connectors.

h) Once you have jumped into the IDC/flat strip cable domain you are stuck there. None of the IDC/flat strip cable catalogs that I have looked at (several) offers a compatible crimp or solder termination cable connector to use as a discrete-wire replacement for an IDC-terminated connector.

i) A flat strip/IDC cable can be built in less time than a crimp or solder termination cable but they must be built carefully, not slopped out just because it's easy to do quickly.

j) If the VLBA Standard Interface board is to be redigned to use flat strip/IDC connectors, the attached sketches show that it is feasible with some re-arrangement of the artwork. This configuration is based upon what I conceive to be a general model for a Standard Interface-controlled module; a sketch of this model is included. Connector types, sizes and signal groupings are shown on the sketches. Note that bus signals and power wires are terminated on discrete wire crimp connectors, no two connectors are identical sizes and the IDC connectors are spaced so that it is not possible to install an IDC connector so that it spans adjacent board connectors.

I have not detailed the costs of this configuration but will do so soon.

I am not enthusiastic about this approach for the reasons cited above but am quite willing to it if so directed.

4) SHOULD THE BUS SIGNALS BE DISTRIBUTED AS TWO CONDUCTOR SHIELDED RUNS OR AS FOUR COAX SIGNALS? -- I favor two conductor shielded runs over four coax lines with the shields of sets connected together at the terminations to preserve signal balance. There are fewer wires to deal with which reduces the possibilities of confusion resulting from inter-changed wires. The signal balance and RFI shielding would probably not be as good. This aspect need some study. If the AMP connector proposed above is acceptable, Twin-ax should be used.

Dimensioning:
Values in brackets are metric equivalents.

MATERIAL, FINISH AND TEST SPECIFICATIONS

The following specifications and standards form a part of this specification:

(See AMP Product Specification 108-12022)

Brass	QQ-B-613, QQ-B-626
Beryllium Copper	QQ-C-533, QQ-C-530
Copper	QQ-C-576
Bronze	ASTM-B-140
Polyethylene	LP-590, MIL-T-3803
Polypropylene	Fed. Spec. L-P-394B Type I
Gold Plating	MIL-G-45204
Nickel Plating	QQ-N-290
Silver Plating	QQ-S-365
Test Method for Electronic and Electrical Component Parts	MIL-STD-202

PERFORMANCE REQUIREMENTS

Insulation Resistance — Insulation resistance of mated contacts is at least 5,000 megohms between the inner contact and outer shell.

Dielectric Withstanding Voltage—The contacts can withstand a potential of 1,500 volts rms for a period of one minute.

Cable Retention — Shell and inner pin contacts withstand tensile pull values shown below when the cable is pulled at a speed of one inch per minute.

RG-71 B/U	55 lbs. [245 N]
RG-55 B/U	85 lbs. [378 N]
RG-62 B/U	75 lbs. [334 N]
RG-223	55 lbs. [245 N]
RG-58 C/U	50 lbs. [222 N]
RG-180 A/U	28 lbs. [125 N]

Contact Resistance — With test current of one ampere flowing in the center contacts, the contact resistance does not exceed 2.0 milliohms.

Low-level Conductivity — With the contacts mated in a connector assembly, both inner and outer contacts will conduct current in either direction with a voltage of 10 microvolts DC applied across each contact pair.

Durability — After being subjected to 500 engagements and withdrawals at a rate not exceeding 10 cycles per minute, the contacts meet the requirements of the foregoing Contact Resistance and Low-level Conductivity tests.

Voltage Standing Wave Ratio — When tested with a long length of coaxial cable, the VSWR does not exceed 1.25 to 1.0 at frequencies up to 2,000 Mhz.

Temperature Cycling — When tested in accordance with MIL-STD-202, Condition D, Method 102 for five cycles, the contacts show no evidence of physical damage.

Vibration — Mated connector assemblies vibrated in accordance with MIL-STD-202, Method 201, for a period of two hours in each of three mutually perpendicular planes do not exhibit any discontinuity greater than 10 microseconds nor show any evidence of physical damage.

Shock — Mated connector assemblies, in accordance with Method 213 Test Condition G of MIL-STD-202, subjected to eight 50-g deceleration shocks in each of three mutually perpendicular axes do not exhibit any discontinuity greater than 10 microseconds nor show any evidence of physical damage. After this test, the assemblies meet the requirements of aforementioned specifications for Insulation Resistance, Dielectric Withstanding Voltage and Cable Retention.

DESIGN AND CONSTRUCTION

Temperature Range — Contacts perform satisfactorily and are capable of being mated and unmated within a temperature range of −55°C to +85°C.

Finish and Plating—Contacting surfaces are smooth and are gold plated to a minimum thickness of .00003 [0.00076] over a minimum nickel subplating of .00003 [0.00076] in accordance with MIL-G-45204 for gold and QQ-N-290 for nickel.

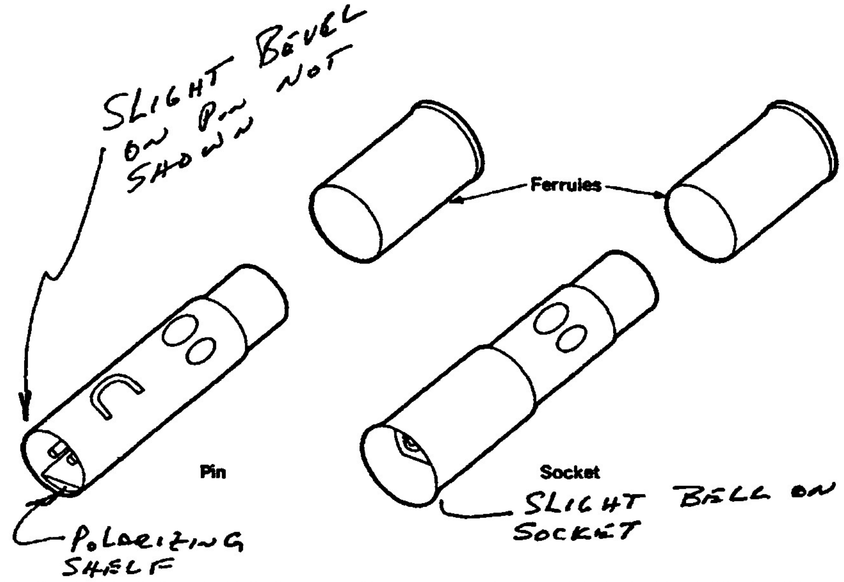
Dimensioning:
All dimensions in inches and millimetres.
Values in brackets are metric equivalents.

Twin Standard COAXICON, Crimp

Material:
Outer Shell–Brass per MIL-C-50
Center Conductor–Brass per QQ-B-626
Inner Dielectric–Polypropylene, General Purpose
Alignment Bushing–Polyethylene LP-390
Retention Spring–Beryllium Copper per QQ-C-533
Ferrule–Copper per QQ-C-576

Finish:
Outer Shell, Center Conductor–.000030 [0.00076] Gold over .000030 [0.00076] Nickel
Retention Spring–Bright Tin-Lead per MIL-T-10727
Ferrule–Silver Plated

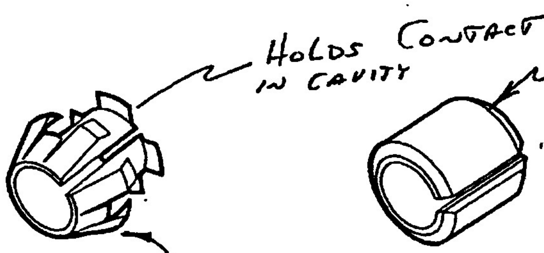
AMP Extraction Tool No. 305141-2



Cable Size/Type	Loose Piece Contact No.		Ferrule No.	Tooling No.	
	Pin	Socket		Die Inserts for Hand Tool 69710-1 or Pneumatic Tools 69365-2 & 69365-3*	Hand Tool
RG/U-108A (Center Conductor Stranded; 7 Str., .0089 [0.23] Dia.)	329009	329010	329041	69231-2	45707-2
Belden 8737 (Spiral Wrapped Shield)	329009	329010	329041	69231-2	45707-2
RG/U-108, RG/U-108A (Center Conductor Stranded; 7 Str., .0126 [0.32] Dia.)	2-329009-1	2-329010-1	329041	69231-2	45707-2
Belden 8762, 8759	2-329009-1	2-329010-1	329041	69231-2	45707-2
2-3932, 2-3934 (Microdot)	329054	329055	329056	69231-2	45707-2
Belden 8451, 8641, 8761	329009	329010	329056	69494-1	45707-4

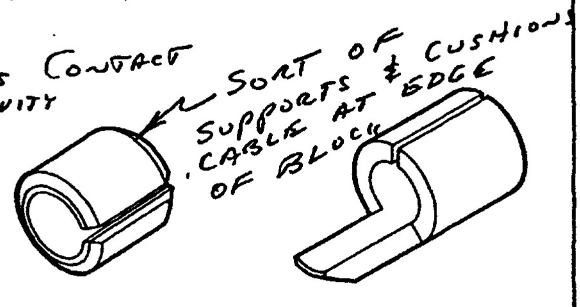
*Requires Manual Take-Up Attachment No. 69689.
Extraction Tool No. 305141-2.

Notes: 1. These contacts are used in the larger circular contact cavities of special application connector housing, 16-position (mixed).
2. A ferrule, retention spring and alignment bushing are required for each pin and socket.



Retention Spring

Part No. 329042



Alignment Bushings

Part No. 329053 Part No. 330576

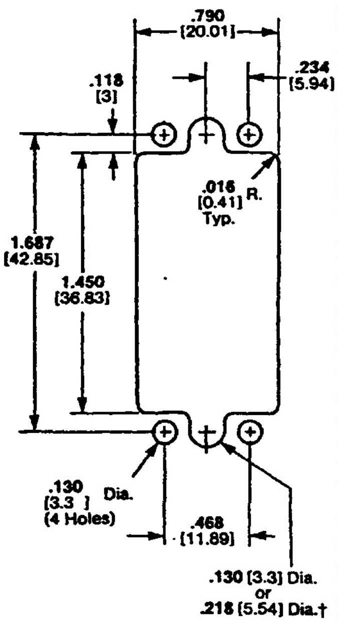
Retention Spring No.	Alignment Bushing No.	Used With	
		Pin No.	Socket No.
329042	329053	329009, 2-329009-1	329010, 2-329010-1
329042	330576	329054, 329009	329055, 329010

ONE OF THESE LEAF SPRINGS ENGAGES A SLOT IN BLOCK CAVITY TO PREVENT CONTACT ROTATION. THERE ARE 6 POSSIBLE ORIENTATIONS OF CONTACT IN BLOCK (POTENTIAL CONFUSION FACTOR)

16 Position (Mixed) Special Application Connectors

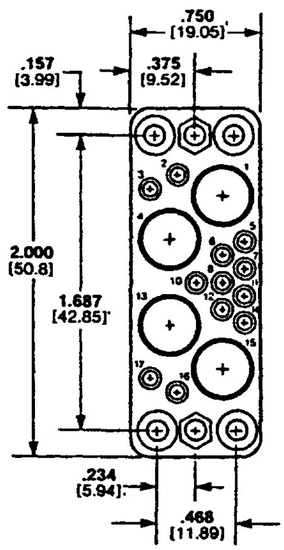
Dimensioning:
All dimensions in inches and millimetres.
Values in brackets are metric equivalents.
Chart contains dimensions in inches over millimetres.

SAME DIMENSIONS AS THE STANDARD 34 PIN CONNECTOR WHICH IS A ULA STANDARD CONNECTOR

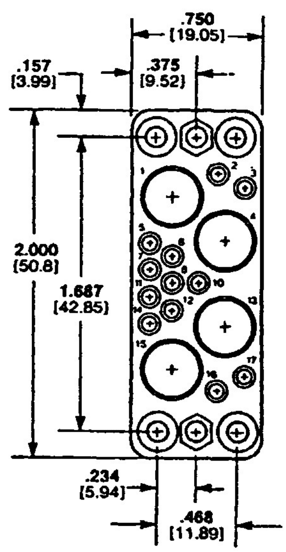


Recommended Panel Cutout

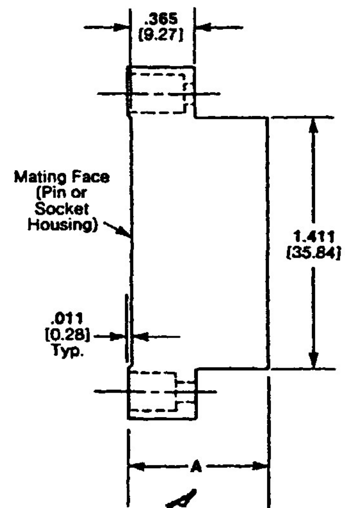
†.218 [5.54] diameter is required when jackscrews are used.



Pin Housing Mating Face



Socket Housing Mating Face



ONLY DIMENSION THAT DIFFERS FROM STD 34 PIN BLOCKS

Housings

A Dim.	Phenolic Housing Part No. Pin	Phenolic Housing Part No. Socket	Diallyl Phthalate Housing Part No. Pin	Diallyl Phthalate Housing Part No. Socket	Contacts Accepted Quantity	Contacts Accepted Contact Type	Contacts Accepted Page Ref.
.757 19.23	202268-2	–	202268-4	–	12*	Type II	14
						Type III+	15-17
						Type VI	18
						Type X	19
1.016 25.81	–	202267-2	–	202267-4		Subminiature COAXICON	23
					4	Twin Standard COAXICON	27

*Quantity may be all of the same type, or a combination of those types listed.

← STANDARD CRIMP PINS & SOCKETS

Hardware (Order Separately)

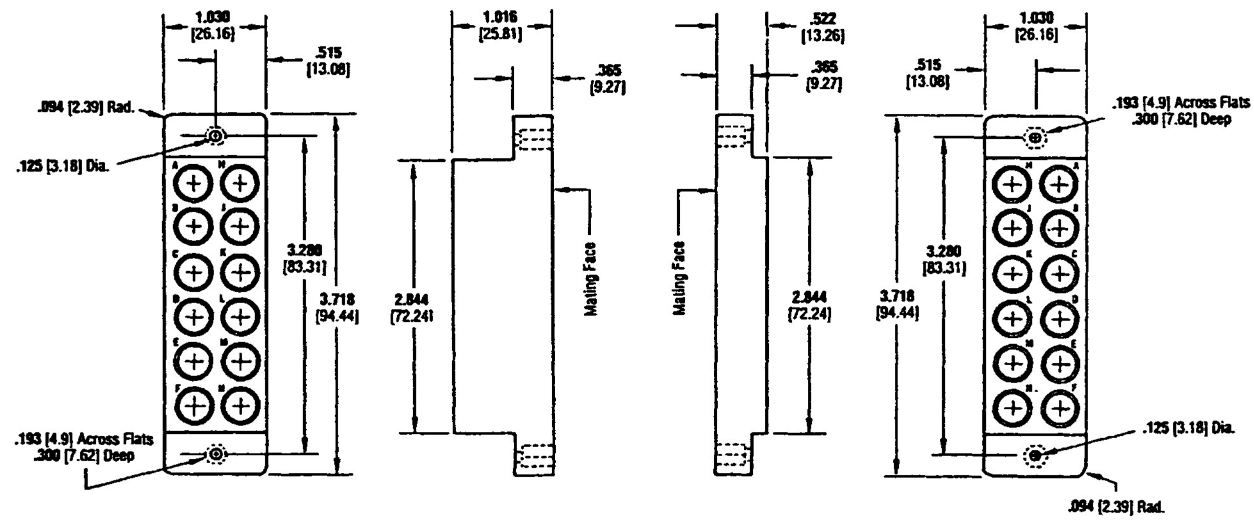
Function	Component	Design Configuration	Page Ref.
Fastening	Jackscrews	Turnable: Long Male, Long Female, Short Male, Short Female, Short-Short Male, Short-Short Female Fixed: Male, Female	82, 83
	Locking Springs	Male (Spring Member), Female (Latching Member)	84
Guiding	Guide Pins and Sockets	Center Pin (Male), Center Socket (Female), Corner Pin (Male) Corner Socket (Female)[1]	85
Protective	Pin Hoods	Internal Open-End, Internal Closed-End, External Closed-End, External Open-End w/Flanges	86, 87
	Shields	One-Piece: 180° Long, 180° Short, 90° Long, 90° Short Two-Piece: 180° Long, 180° Short	88, 89 & 90
Strain Relief	Strain Relief Clamps	Long, Short	92
Keying	Keying Plugs	For Multimate Contact Cavities	93

[1] Use longer Corner Female Guide Sockets when housings are loaded with subminiature COAXICON contacts.

Note: All available hardware for use with 16-position mixed connector housings are listed above. Pages referenced in the chart provide detailed specifications and part nos. for ordering the individual hardware components

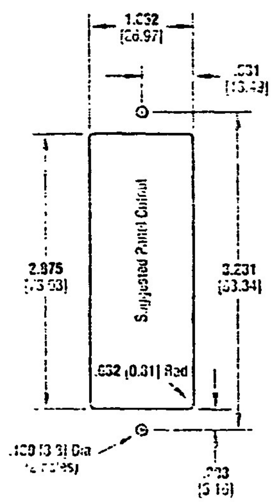
Dimensioning:
All dimensions in inches and millimetres.
Values in brackets are metric equivalents.

12 POSITION TWIN STANDARD



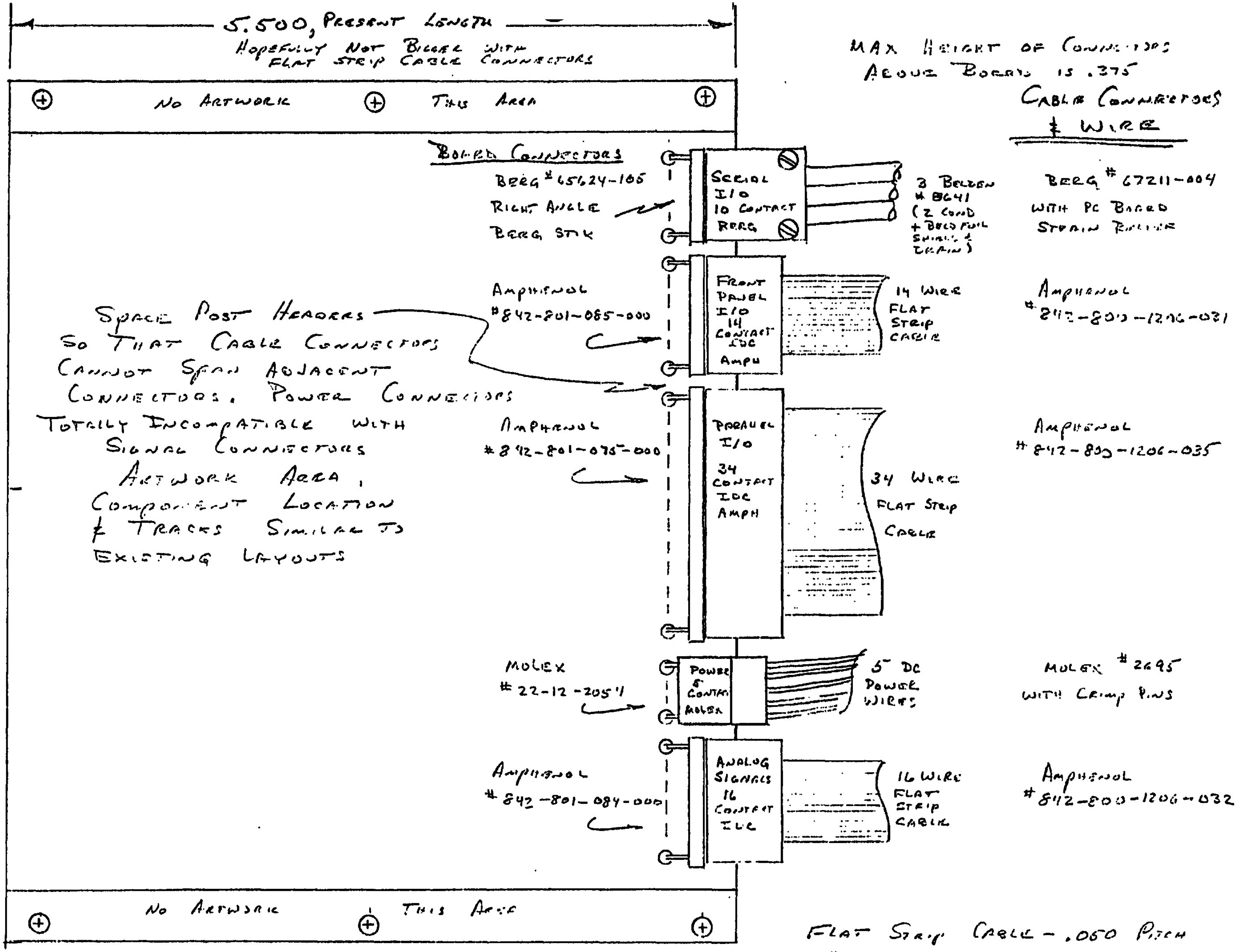
SOCKET HOUSING

PIN HOUSING



HOUSING ASSEMBLIES

MALE HOUSING PART NUMBER	SOCKET HOUSING PART NUMBER	MATERIAL & COLOR
201152-1	201153-1	Phenolic, Black
201152-2	201153-2	Diallyl Phthalate, Blue
201152-6	201153-6	Diallyl Phthalate, Black

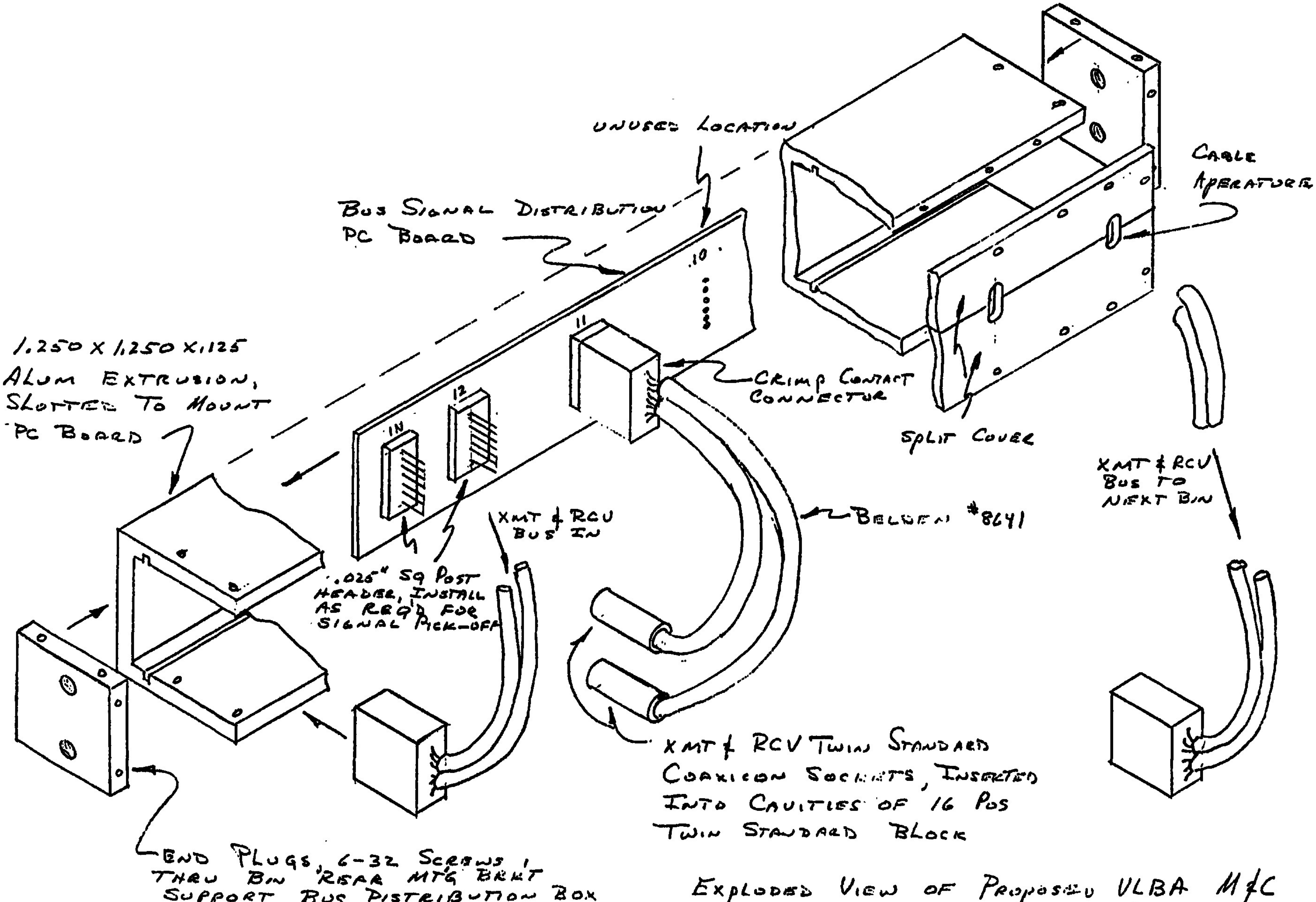


FLAT STRIP CABLE - .050 PITCH
28 WIRE, UNSHIELDED,
AMPHENOL, 3M, ETC.

FLAT STRIP CONNECTORS
HAVE STRAIN RELIEFS

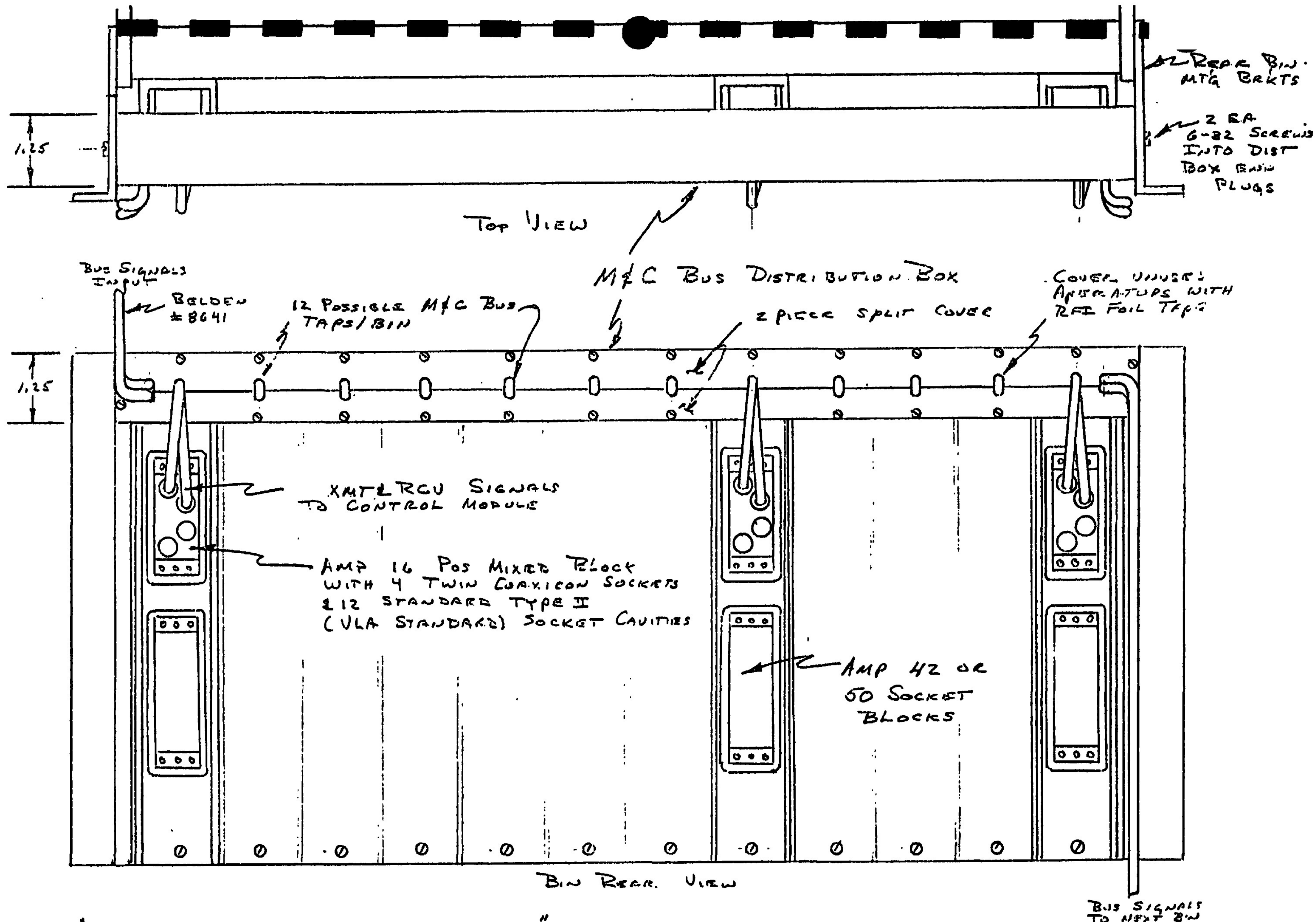
PHYSIQUE OF FLAT-STRIP-CABLED VLBA
STD INTERFACE BOARD

D. WEBER 9/24/85



Exploded View of Proposed VLBA M/C Bus Signal Distribution Box

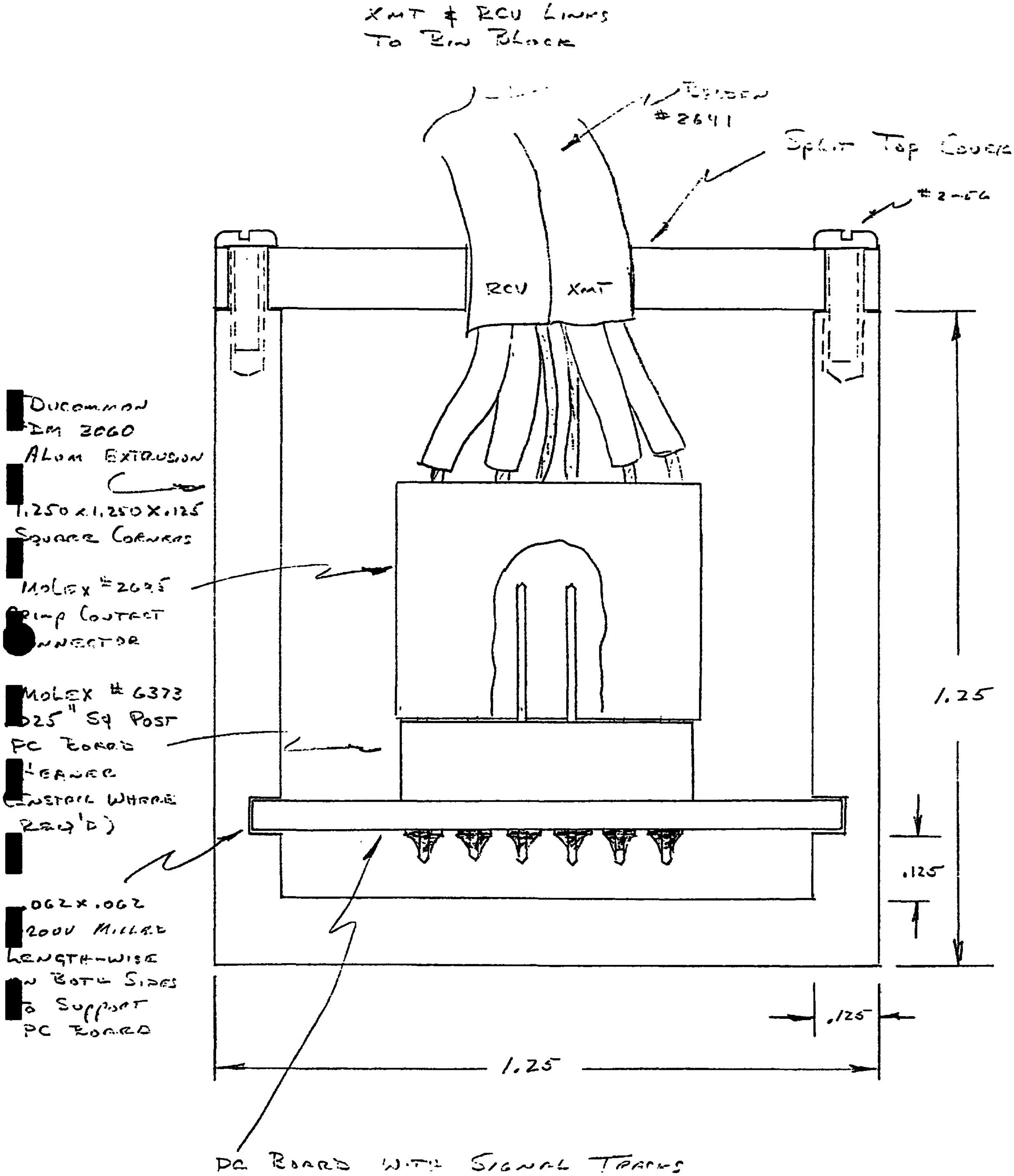
Hand-Drawed By Weber 9/27/86



"It Is Better To XMT Than To RCV" Weber

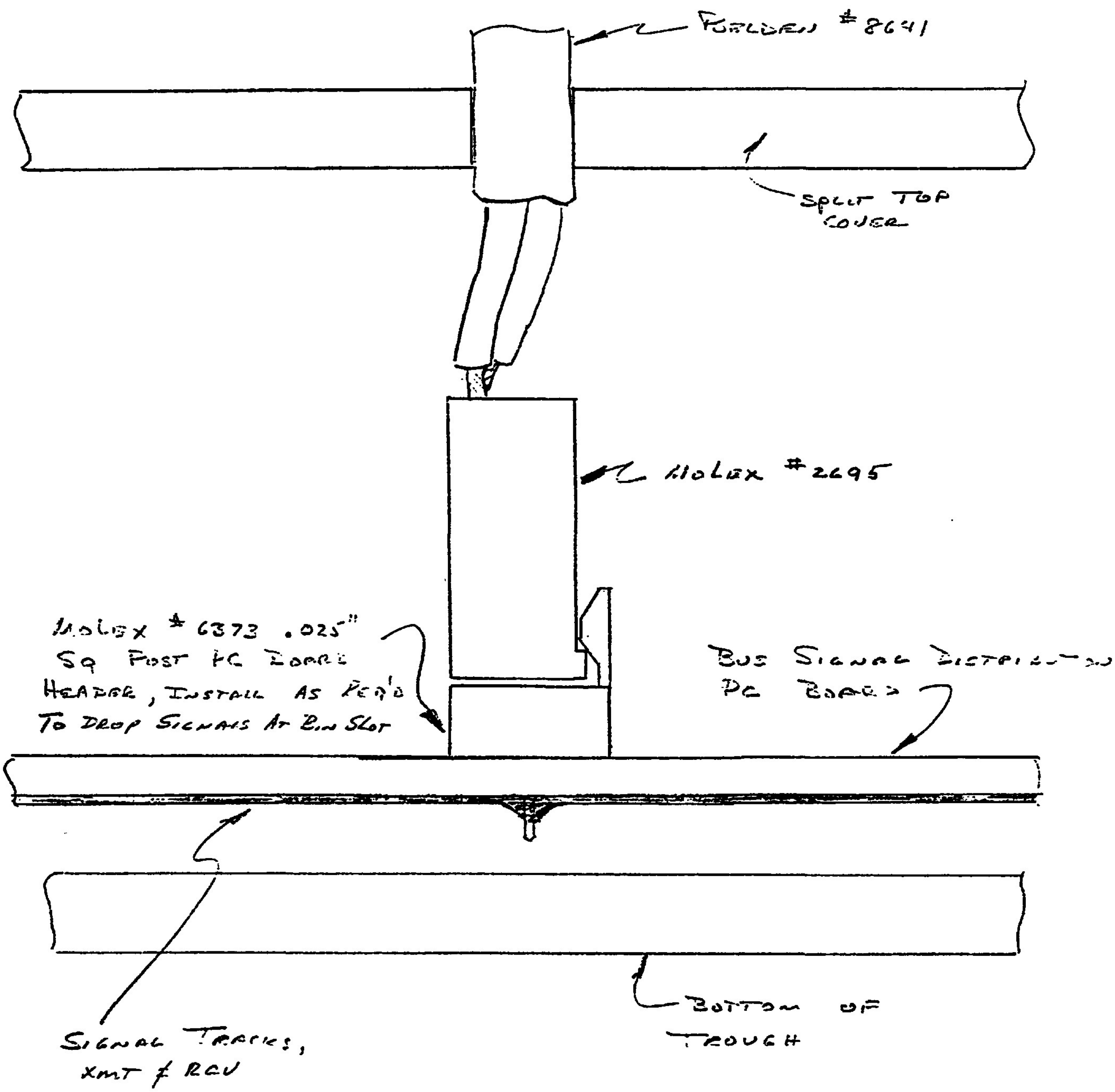
Proposed VLBA M&C Bus Signal Distribution Box Installed on Rear of Bin, Drawn Approximately To Scale

Hand Drawn By Weber
9/27/85



Hand-Drawn By Weber 9/26/85

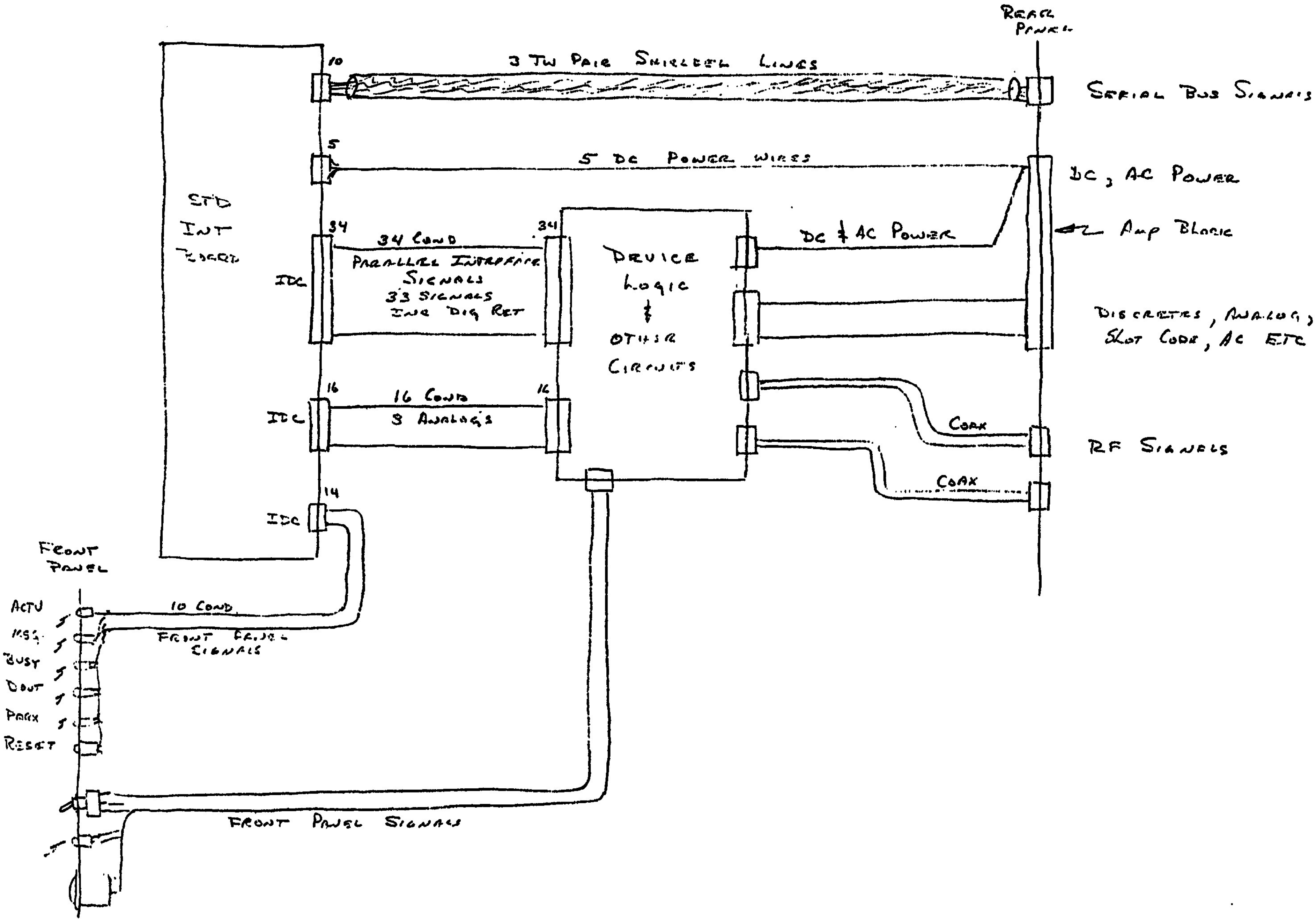
Cross-Section View of ULBA M&C
Bus Signal Distribution Box



HAND-DRAWED BY WEBER
9/26/85

LONGITUDINAL SECTION VIEW OF
ULBA M&C BUS SIGNAL
DISTRIBUTION BOX

Ribbon Cable-Harnessed [redacted]anonical Module, Slot Code Scheme For Address Assignment 9/23/85/DW/WR



ULCA PARALLEL CONTROL INTERFACE CONNECTORING
USING SLOT CODE SCHEME FOR ADDRESS BLOCK
IDENTIFICATION PER CLARKS SCHEME 9/23/85

POWER (NON IDC) – +5, 5V COMM, -15, +15, ±15V COMM (5 WIRES)

SERIAL I/O (NON IDC) – XMT +/-, RCV +/-, RESET +/- & SHIELD(S), 7 OR 9 WIRES, SHIELD TIED TO MODULE GND ON PC BOARD, NOT LOGIC GND

PARALLEL INTERFACE SIGNALS TO DEVICE LOGIC – IDC

ADDR	–8	
CMD/MON	–16	
ADENB	–1	
DEV ACK	–1	Σ = 32 WIRES, USE 34 CONTACT IDC
HI/LO SEL	–1	
PORT PINS	–3	
INT	–1	
DIG RET	–1	

FRONT PANEL SIGNALS – IDC

LED DRIVE	–5	
+5 FOR LED	–1	Σ = 8 WIRES, USE 14 CONTACT IDC
RESET SW	–1	
DIG RET	–1	

ANALOGS – IDC, 16 WIRES, 16 PIN IDC

BOARD PACKAGE GROUND RULES:

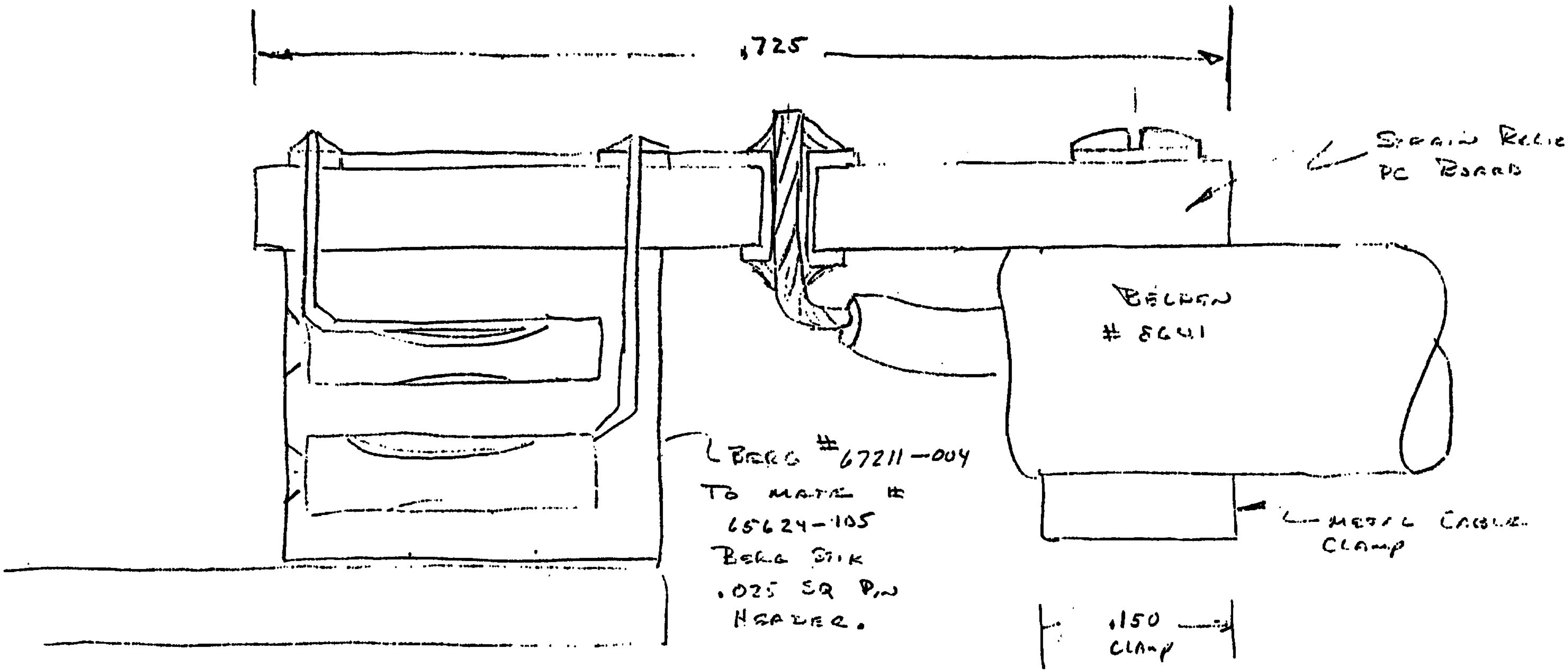
1) BOARD MUST FIT INTO 1W MODULE BY: a) MOUNT ON MODULE RAILS WITH NO PARTS CONTACT TO 1W SCREEN COVER; b) MOUNT BETWEEN RAILS ON STANDOFF SPACERS, BOARD FLANGES (TRANSVERSE TO MODULE LONG DIMENSION) BOARD MUST BE TRIMMED TO DO SO

2) BOARD POWER CANNOT BE IDC BECAUSE OF LOW CURRENT CARRYING CAPACITY OF IDC CONTACTS, USE .025 SQ POST/CRIMP PINS CONNECTOR

3) SERIAL I/O LINES MUST NOT BE IDC BECAUSE IT MUST BE SHIELDED & SHIELDED IDC CONNECTORS DO NOT HAVE PROVISIONS TO CONNECT SHIELD VIA CONNECTOR.

4) KEEP SIZE AS SMALL AS POSSIBLE

Conn	# Contacts	Board Type & $	Cable Type & $
Serial I/O Signals	10	.025" SQ, Right Angle Posts, Berg # 65624-105 Cost =	Crimp Contact, Berg # 672.-004 Cost =
Front Panel Signals	14	.025" SQ, Right Angle Posts, Amphenol # 842-801-085-000 Cost =	IDC Flat Strip Amphenol # 842-800-1206-031 Cost =
Parallel Int I/O Signals	34	.025" SQ, Right Angle Posts, Amphenol # 842-801-075-000 Cost =	IDC Flat Strip Amphenol # 842-800-1206-035 Cost =
Power Wires	5	.025 SQ Post, Right Angle, Single Row With Lock, Molex # 22-12-2054 Cost =	Crimp Contact, With Lock Molex # 2695 Cost =
Analog Signals	16	.025 SQ, Right Angle, Amphenol # 842-801-084-000 Cost =	IDC Flat Strip, Amphenol # 842-800-1206-032 Cost =


.725
Strain Relief PC Board
Belden # 8641
Berg #67211-004 To mate # 65624-105 Berg Stik .025 SQ Pin Header.
Metal Cable Clamp
.150 clamp