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FAA PRINTED CIRCUIT BOARD ANALYSIS-CATEGORIZATION AND DATA COLLECTION

Gerald L. Ginsberg

December 1973

Final Report

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16. Abstract

This report establishes a system to categorize printed circuit boards. The system defines levels of each category or group and where necessary degrees within each category or group. The categorization system was arrived at after evaluation of data collected on FAA printed circuit boards with consideration of various Government and Industry documents which relate to this subject. A comprehensive analysis and cost vs. benefit study are contained in subsequent reports.

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1.0 PREFACE

Federal Aviation Administration Engineering Requirement FAA-ER-650-013 (July 30, 1971) provides for a comprehensive program to analyze the present use of printed circuit boards by the FAA and to establish the standards for future control and application of printed circuit boards in FAA electronic equipment.

The resulting Printed Circuit Board Study (PCBS) to implement this effort is divided into two tasks, namely:

Task I - Analysis of existing printed circuit board status

Task II - Standards for future equipment utilizing printed circuit cards

For efficient analysis and reporting purposes both Tasks have been subdivided as follows:

Task Ia - Categorization , FAA-RD-74-108

Task Ib - Data Collection , FAA-RD-74-108

Task Ic - Comprehensive Analysis , FAA-RD-74-109

Task IIa - Cost versus Benefit Study , FAA-RD-74-111

This report covers the Categorization and Data Collection portions of the Printed Circuit Board Survey.

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1.0 CATEGORIZATION

In accordance with the requirements of FAA-ER-650-013 (July 30, 1971) Philco-Ford established a system to categorize printed circuit boards. The System defines the limits of each category or group and, where necessary, degrees within each category or group. The following Categorization System was arrived at after evaluation of the Data Collection effort under the Printed Circuit Board Survey (see Section 2.0) and the consideration of various Government and Industry documents which relate entirely or in part to this subject.

1.1 POPULATION AND RELATIVE COST

A major element of the Categorization System pertains to the population of units involved and their relative costs as these relate directly to the trade-offs associated with Life Cycle Costing and the generation of meaningful standards. Too often these items are overlooked by contracting agencies. As a result, many development contracts requiring only a few deliverable units will be designed for the use of model shop tooling and fabrication techniques. If the development contract had specified that the design be generated taking into account the ultimate population of the units to be procured, the initial equipment contractor would base his trade-offs on the most cost-effective basis and maximum benefit would be accrued by the Federal Aviation Administration.

The basic elements of population and relative cost can be combined, using the following equation, to give a population/cost factor suitable for definition purposes.

$$\text{P/C Factor (PCF)} = FC/P + UC$$

where:

FC = Fixed Costs for the unit including design, documentation, and tooling

P = Population being considered

UC = Unit Cost for the fabrication, assembly, and testing of the unit

With the information presently available, there does not appear to be a significant rational to support the definition of population/relative cost categories, such as $100 or less, $100 to $250, etc. The population and relative cost of a printed wiring assembly is usually the result of circuit partitioning decisions based on primarily performance optimization considerations. Therefore, an attempt to define categories based on mechanical (size/quantity) or economical (cost) considerations would be arbitrary and not as significant as the other elements of categorization covered in the following text of this Study.

1.2 EQUIPMENT TYPE

Consideration was given to having an element of the Categorization System relate to equipment type. For example, MIL-E-5400 (Electronic Equipment, Airborne, General Specification) defines five classes of equipment depending on altitude and temperature range.

Another alternate approach is also found in MIL-E-5400N which divides contracts for electronic equipment into the following categories:

"Category I: Contracts which are fundamentally for the purpose of investigation or study and not for the fabrication of equipment. A research model may result from such a contract.

Category II: Contracts for one or more models of equipment designed to meet the performance requirements of a specification to establish technical requirements for production equipment. This category includes contracts for models to be used for test under service conditions for the evaluation of their suitability and performance.

Category III: Contracts for production equipment. These contracts will usually include requirements for a prototype or preproduction model.

For FAA applications the most practical approach to Equipment Type categories is found in MIL-STD-280 which defines equipment types as follows:

A. EXPLORATORY DEVELOPMENT CATEGORY

An item (preliminary parts or circuits) used for experimentation or tests to investigate or evaluate the feasibility and practicality of a concept, device, circuits, or system in breadboard or rough experimental form, without regard to the eventual overall fit or final form.

B. ADVANCED DEVELOPMENT CATEGORY

An item used for experimentation or tests to (a) demonstrate the technical feasibility of a design, (b) determine its ability to meet existing performance requirements, (c) secure engineering data for use in further development and, where appropriate, (d) establish the technical requirements for contract definition.

C. ENGINEERING DEVELOPMENT (Service Test) CATEGORY

An item used in tests to determine tactical suitability for government use in real or simulated environments for which the item was designed. It closely approximates an initial production design, has the required form, employs standard parts (or nonstandard parts approved by the agency concerned).

D. PREPRODUCTION (Prototype) CATEGORY

An item suitable for complete evaluation of form, fit, and performance. It is in final form in all respects, employs standard parts (or nonstandard parts approved by the agency concerned), and is completely representative of final equipment.

E. PRODUCTION CATEGORY

An item in its final form or final production design made by production tools, jigs, fixtures and methods. It employs standard and approved nonstandard parts.

1.2.1 ENVIRONMENTAL CONDITIONS

An appropriate subgrouping under the Equipment Type categories defined above can be found in FAA-G-2100c which defines environmental conditions of three categories, namely:

Environment I	For equipment installed in attended facility.
Environment II	For equipment installed in unattended facility.
Environment III	For equipment installed outdoors.

Table 1-1 defines the environmental conditions for each of the above subcategories.

Table 1-1. Environmental Conditions for Equipment Type Subcategories

Environment Subcategory	Temperature (degrees C)	Relative Humidity (percent)	Altitude (feet above sea level)	Wind (mph)	Ice Loading
I	+10 to +50	10 to 80	0 to 10,000	-	-
II	-10 to +50	5 to 90	0 to 10,000	-	-
III	-50 to +70	5 to 100	0 to 10,000	0 to 100	encased in 1/2" ice

1.3 SUBASSEMBLY TYPE

A categorization area to consider subassembly type should differentiate between Mechanical and Electrical attributes of a printed wiring subassembly. The following text describes the most logical items to be included under each element of categorization.

1.3.1 ELECTRICAL

A. Function-Oriented - Printed wiring assemblies used primarily in equipment where several large subassemblies are employed and each subassembly performs a major function with a minimum of interconnection wiring.

B. Gate-Oriented - Printed wiring assemblies which are used primarily in equipment where large quantities of a few relatively small basic subassemblies are employed, with the overall equipment usage predicated on a high degree of back-panel interconnection wiring. (The use of gate-oriented printed wiring assemblies is characteristic of digital equipments with a high degree of modularity.)

C. Interconnection-Wiring - Printed wiring assemblies (sometimes called "mother boards" or "backpanels") which provide the wiring to interconnect plug-in printed wiring assemblies. The basic components used with these assemblies are interface connectors, as opposed to active and passive circuit elements which predominate Function- and Gate-oriented assemblies. Interconnection-wiring printed wiring assemblies can be multilayer to supply all of the interconnections in "printed" form or enhanced with discrete "hook-up" wiring while performing only a power distribution and grounding mechanism in the form of printed wiring.

1.3.2 MECHANICAL

A. Plug-in - Printed wiring assemblies which interface with their interconnection-wiring media through the use of separable (non-permanent) mechanical contacts.

B. Non-Plug-in - Printed wiring assemblies which interface with their interconnection-wiring media through the use of permanent (usually soldered) input/output connections.

1.4 PRINTED WIRING FEATURES

There are many features of printed wiring boards which can be used for categorization purposes, in order to provide a means for differentiating among them. The most significant features of the basic printed wiring board suitable for use as elements of a Categorization System or defined in the following text.

1.4.1 NUMBER OF LAYERS

A. Single-Sided - a printed wiring board with one layer of conductor patterns on a dielectric base with or without a coverlay of dielectric material.

B. Double-Sided - a printed wiring board with two parallel layers of conductor patterns separated by a dielectric base material. The conductive patterns on both layers are usually interconnected by means of an interfacial connection.

C. Multilayer - a printed wiring board with three or more parallel layers of conductor patterns separated by dielectric material(s). The conductive patterns on the conductor layers are usually interconnected by means of plated-through-hole interfacial connections.

1.4.2 SUBSTRATE MATERIAL

A. Rigid - a printed wiring board with a rigid or low degree of flexure. The dielectric material usually has a glass or paper base, with an epoxy or other material for reinforcement.

B. Flexible - a printed wiring board with a high degree flexibility. The dielectric material is often one of the following: TFE plastic, TFE glass cloth, FEP plastic, FEP glass cloth, polyimide film, etc. Such printed wiring is often complimented with a cover coat to protect the wiring from moisture, contamination and damage of a similar composition as the base dielectric.

1.4.3 INTERFACIAL CONNECTIONS

A. Plated-through - an interfacial connection formed by the deposition of metal on the walls of a through hole, electrically connecting respective terminal areas of different layers of the printed wiring board.

B. Eyelet - an interfacial connection (for use on double-sided printed wiring boards) which is in the form of a short metallic tube, the ends of which can be bent outward and over to facilitate the subsequent soldering of the eyelet to terminal areas on each side of the printed wiring board.

C. Formed-wire - an interfacial connection (for use on double-sided printed wiring boards) in the form of a wire which passes through the interconnection hole and has its ends soldered to terminal areas on each side of the printed wiring board.

1.5 CIRCUIT COMPONENTS

1.5.1 COMPONENT DENSITY

Originally the element of the Categorization System pertaining to circuit components considered grouping on the basis of the approximate count of components - none, less than five, five to fifteen, etc. or some other quantity grouping. Philco-Ford has found that a more significant and meaningful approach to categorization in this area is achieved when based on component density, instead of the number of components.

A magnitude of component density can be obtained by dividing the area on a board used for components (including terminal areas and wiring paths) by the usable board area. This relationship can be define the following factor suitable for categorization purposes -

$$CD = CA / UA$$

where: CD = Component Density
CA = Component Area
UA = Usable Area

More details concerning the use of this equation and its applicability to printed wiring boards is contained in the report on the Data Analysis portion of the FAA Printed Circuit Board Survey.

1.5.2 COMPONENT TYPE

Categorization with respect to circuit component type initially considered grouping into discrete two- or three-lead components and multiple-lead integrated circuit components. Additional consideration was given to secondary features of components which tend to differentiate one from another, such as components with leads on a circular pattern (transistors and integrated-circuit cans) and components with flat ribbon leads (integrated-circuit flatpacks), or resistors of different size due to variations, such as wattage.

After a careful evaluation of the printed wiring board assemblies in FAA equipment and their circuit components, the most practical areas for categorization concerning component type are as follows:

A. Conventional - Circuit components with two or three leads which perform basic electrical functions, such as resistors, capacitors, diodes, and transistors.

B. Integrated Circuits - (reference MIL-STD-1313A) A microcircuit consisting of interconnected elements inseparably associated and formed in situ on or within a single substrate to perform an electronic circuit function.

(1) Small Scale - Containing in each microcircuit the equivalent of up to 20 gates.

(2) Medium Scale - Containg in each microcircuit the equivalent of from 20 to 100 gates.

(3) Large Scale - Containg in each microcircuit the equivalent of from 100 to 1000 gates.

C. Hybrid - (reference MIL-STD-1313A) A microcircuit consisting of elements which are a combination of the film circuit type and the semiconductor types or a combination of one or both of the types with discrete parts.

D. Special - Components such as transformers, filters, etc. which may be irregular in size and shape and with a variable number of leads.

1.6 REPAIR

Repairability and repair costs are major elements of Life Cycle Costs for an equipment user, such as the F. A. A. and represent critical manpower (skills, training, and availability) and tooling demands. For this reason a significant part of this Task I effort to develop a Categorization System deals with the Repair element.

Items of repair considered varied from "extensive depot repar" to "throwaway". Additional areas covered related to on-site repair and maintenance depot repair, with further refinements or subgroups for differentiation within repairman training and skill levels. For example, printed wiring boards designed primarily with plug-in circuit components are readily repaired "on-site" by a repairman without special training and skills. Whereas large function-oriented printed wiring assemblies with many integrated circuit and discrete components may require repairman with special training and skills at the depot level.

The need for special training and skills is evidenced by programs made available to repairman by the F. A. A. at the Oklahoma City school and special courses of instruction provided by Pace Incorporated of Silver Springs, Maryland a company specializing in systems and technology for rework repair and modification.

Based on these consideration, the following definitions have been chosen for the Repair element of the Categorization System:

1.6.1 REPAIR TYPE

A. Local - Repairs made at the equipment installation by the repairman directly responsible for the particular equipment being maintained.

B. Remote - Repairs made at a central location, maintenance depot, by a repairman responsible for several types of equipments.

C. Throwaway - No repairs on the printed wiring board assembly. Equipment maintenance performed by direct replacement of the entire assembly by an interchangeable "spare".

1.6.2 REPAIR ELEMENT

A. Printed Wiring Board - Repairs made to the basic printed wiring board structure and/or interconnection wiring.

B. Circuit Component - Repairs made to an individual component or components of the printed wiring board assembly, usually in the nature of direct component replacement.

C. Lead Termination - Repairs made at the interfacial termination between the circuit component lead and the printed wiring board terminal area.

1.6.3 REPAIR TECHNIQUE

A. Manual (unaided) - Repairs made by personnel without special training or skills using conventional repair tools, such as hand soldering irons, pliers, etc.

B. Manual (aided) - Repairs made by experienced repairman using conventional repair tools with the aid of printed wiring repair oriented aids such as solder removers, optics, etc. Repairman preferably has received formal repair training at the F. A. A. school at Oklahoma City, Oklahoma.

C. Semi-automatic - Repairs made by personnel experienced and trained in the use of semi-automatic repair equipment, such as that made by Pace Incorporated, Silver Springs, Md.

1.7 TESTING (Troubleshooting, Diagnostics, Tools and Equipment)

When test provisions are provided in an equipment they facilitate performance evaluation, malfunction detection and correction, troubleshooting, diagnostics, etc. The specific test provisions depends upon the operational and maintenance demands placed on the equipment by the maintenance concept. For these reasons Testing is included in the Categorization System.

A review by Philco-Ford of existing F. A. A. equipment, test facilities, and interviews with appropriate F. A. A. personnel has resulted in the following definitions for the Testing element of Categorization:

1.7.1 DEGREE OF TESTING (reference MIL-STD-415D)

A. Go-No Go - Testing that presents results by an showing the condition or state of operability in either of two parameters, "Go" functioning properly, or "No Go" not functioning properly.

1. Presence tests verify the presence or absence of item signals or characteristics. Such signals or characteristics are those which are not tolerance critical to operation.

2. Comparative tests compare item signal or characteristic values with a specified tolerance band and present the operator with a Go-No Go readout; a "Go" for signals within tolerance, and a "No Go" for signals out of tolerance.

B. Marginal Testing - Testing that presents results on an indicator that has tolerance bands for evaluating the signal or characteristic being tested. (For example: a green band might indicate an acceptable tolerance range;a yellow band representing marginal operation; and a red band indicating that there is unsatisfactory operation.)

C. Quantitative Testing - Testing that monitors or measures the specific quantity, level, or amplitude of a characteristic to evaluate the operation of an item. The output of such tests are presented as finite or quantitative values of the associated characteristic.

1.7.2 TESTING CAPABILITY (reference MIL-STD-415D)

A. Built-In-Test - Testing capability to assure the effective implementation of the maintenance concept by providing the following:

1. Self-test provisions as an inherent part of the item. These provisions serve a dual function; item performance evaluation, and complementing built-in test provisions to provide item testing. When self-test provisions are practical they do not jeopardize the operation or performance of the item.

2. Marginal testing whereby critical item parameters or characteristics which are subject to change or drift are tested as desfined above in 1.7.1 (B).

B. Test Points - A testing capability in the form of a convenient and safe access to a single point in a circuit to measure or inject a significant quantity for the purpose of evaluation or troubleshooting. Test points are usually used to perform quantitative testing as defined above in 1.7.1.(C).

1. Internal test points are located within the item and provide for the connection of measuring equipment, (normally of the "stand-off" type).

2. External test points are located at readily accessible areas of the surface of the equipment and provide for the connection of measuring equipment, (normally of the "jack" type).

C. Automatic Checkout and Monitoring - A testing capability which allows for the use of equipment which is designed to automatically conduct the analysis of functional or static parameters, evaluate the degree of performance degradation, and perform fault isolation of item malfunctions.

1. External receptacle automatic testing is accomplished by the availability of an accessible electrical receptacle that is mounted on an external surface of the equipment being tested.

2. Internal receptacle automatic testing is accomplished when the item is removed from the equipment. Each module or assembly thus tested normally has input and output connections to permit the application of externally generated stimulus, and external external measurement of performance.

1.8 MAINTENANCE

The role of printed wiring board maintenance is important during the life of an equipment. With the use of increasingly reliable components and skilled maintenance procedures and equipment it is poossible to achieve significantly improved mean-time-between-failure (MTBF) levels and thus reduce equipment repair and logistics costs. Therefore to complement the elements of the Categorization System pertaining to Repair and Testing, the following Maintenance Provisions category is provided. (Reference MIL-STD-415D)

Class A - Provisions for determing the performance of an item by determining if the equipment is functioning within performance limits.

Class B - Provisions for determing the performance of an item which are isolated to malfunctions in a replaceable unit.

Class C - Provisions for determining the performance of an item which are isolated to malfunctions in a replaceable module or assembly.

Class D - Provisions for determining the performance of an item by the use of test points, see 1.7.2(B), that can be used to isolate malfunctions on fixed circuitry to an individual circuit element or component.

2.0 DATA COLLECTION

2.1 FAA FACILITIES

Philco-Ford reviewed the printed circuit boards and their application in all of the equipmented listed in Table 2-1. Data was collected during visits to FAA facilities in Washington (D.C.), Leesburg (Virginia), Oklahoma City (Oklahoma), Fremont (California), Aurora (Illinois), Chicago (Illinois), and Newark (New Jersey).

2.1.1 FAA Library. The FAA library (Washington, D.C.) was visited on 5-7 July and 2 November at which time data was obtained on most of the equipment listed in Table 2-1. A summary of the data obtained from the library is contained in Appendix A to this report.

2.1.2 FAA Air Traffic Control Towers. In order to gather data on actual FAA maintenance procedures two Air Traffic Control Towers were visited, namely those at the Washington, D.C. (6 July 1972) and Chicago, Illinois (15 September 1972) airports. In addition the FAA facility at the Newark, New Jersey airport was visited on 5 October 1972 in order to obtain photographs of the printed wiring boards in the ASR-7 Airport Surveillance Radar.

2.1.3 FAA Air Route Traffic Control Centers. In order to gather data on actual FAA maintenance procedures three Air Traffic Control Centers were visited, namely those at Leesburg, Virginia (6 July 1972), Fremont, California (14 September 1972), and Aurora, Illinois (15 September 1972).

2.1.4 FAA Aeronautical Center. The FAA facility at Oklahoma City, Oklahoma was visited (24-28 July 1972) primarily to obtain photographs of the printed wiring boards in most of the equipment listed in Table 2-1. A total of 685 photographs were taken of 757 printed wiring board assemblies.

Various FAA personnel were interviewed concerning the usage, maintenance, etc. of particular units of FAA equipment, especially Mr. Don Morris who is in charge of FAA printed wiring repair.

Table 2-1. FAA EQUIPMENT

FAA	Nomenclature	Contractor	Title
2449	RBDE-5	Raytheon	Radar Brite Display Equipment
6400	RTC-3	Raytheon	Test Monitor Control Equipment
7200	ATCBI-3	Whitaker	Air Traffic Control Beacon
	ATCBI-4	Tasker	Air Traffic Control Beacon
7280		Airborne Inst. Lab	ATCBI-3 Storage Tube Defruiter
7847	BRITE-1	ITT Aerospace	Bright Radar Indicator Tower Eqpt.
7861	RVR	Solid State Rads.	Runway Visual Range System
7900	CDC	Raytheon	Computer Display Channel
7919	CUE	Raytheon	Computer Update Equipment
7951		Electronic Labs	Coded Time Source
8000	Mark IA	Wilcox	Instrument Landing System
8049		Texas Instruments	Video Mapper Group
8100		Cutler-Hammer	Beacon Video Defruiting Eqpt.
8142		Chain Lakes Res.	Doppler VOR Sideband Ant. Monitor
8144		Leach	Five Channel Recorder
8150	ASRDS-3	ITT Aerospace	Airport Surveillance Radar Display
8165		GRM	Radio Channel Control Equipment
8178	BRITE-2	ITT Aerospace	Bright Radar Indicator Tower Eqpt.
8195	BUEC	ITT Aerospace	Back-Up Emergency Communications
8200	ASR-7	Texas Instruments	Airborne Surveillance Radar
8300	ARTS-III	Univac/Texas Inst.	Automated Radar Terminal System
8400	RBDE-6	Westinghouse	Radar Brite Display Equipment
8451	RML-6	Collins Radio	Radio Microwave Link
8610	Mark IB	Cutler-Hammer	Instrument Landing System
8886		Stelma	Eight Channel Data Terminal
	FDEP	I.B.M.	Flight Data Entry and Printout
	WFMU		Weather and Fixed Map Unit
	MX-8757	Cardion	Navy Beacon Video Defruiting Eqpt.
	TU-9	Collins Radio	Fifty-Watt UHF Transmitter
	TV-35	Wilcox	VHF Eight-Watt Transmitter
	TV-36	Collins	Fifty-Watt VHF Transmitter
	CCC	I.B.M.	Central Computer Complex
	AN/FYQ-47		Common Digitizer

2.2 PRINTED WIRING BOARDS

Color photographs were taken of 779 printed wiring boards used in the FAA equipment listed in Table 2-1. The number of photographs taken for each equipment is as follows:

99	RBDE-5	Radar Brite Display Equipment
33	RTC-3	Test Monitor Control Equipment
17	ATCBI-3	Air Traffic Control Beacon
3	FA-7280	ATCBI-3 Storage Tube Defruiter
17	RVR	Runway Visual Range System
36	FA-7951	Coded Time Source
21	Mark IA	Instrument Landing System
8	MX-8757	Navy Beacon Video Defruiter
127	CDC/CUE	Computer Display Channel/ Computer Update Equipment
22	FA-8049	Video Mapper Group
5	FA-8142	Doppler VOR Sideband Antenna Monitor
11	FA-8144	Five Channel Recorder
21	ASRDS-3	Airport Surveillance Radar Display
32	BRITE-2	Bright Radar Indicator Tower Eqpt.
16	BUEC	Back-Up Emergency Communications
152	ARTS-III	Automated Radar Terminal System
17	RBDE-6	Radar Brite Display Equipment
14	Mark IB	Instrument Landing System
15	WFMU	Weather and Fixed Map Unit
56	AN/FYQ-47	Common Digitizer
6	CCC	Central Computer Complex
39	ASR-7	Airport Surveillance Radar

Each of the printed wiring board photographs was analyzed and data concerning each board coded using the Data Collection Worksheet shown in Figure 2-1. A tabulation of the resulting data is shown in Appendix B. The basic elements of the Worksheet data are as follows:

Columns 1-3	Sequence Number - an assigned number from 001 to 999.
Columns 4 - 10	Equipment Title - up to seven alphanumeric characters to represent the FAA equipment.
Columns 11-17	P.W. Board Title - up to seven alphanumeric characters to represent the printed wiring board.
Columns 18-24	Board Size - three basic printed wiring board size features.
Columns 18-20	Board length - overall board length in tenths of an inch, 3-places, 99.9-inches max.
Columns 21-23	Board width - overall board width in tenths of an inch, 3-places, 99.9-inches max.
Column 24	Number of wiring layers - from 1 to 9 interconnection wiring layers.
Columns 25-28	Input-Output - two basic features of printed wiring board input-output connections.
Column 25	Connector code - one alphanumeric character to represent the type of input-output connector used. See Table 2-2 for details.
Columns 26-28	Contacts used - total number of input-output connections to the printed wiring board exclusive of redundancy, 3-places, 999 max.

DATA COLLECTION WORKSHEET

FAA PRINTED CIRCUIT BOARD SURVEY

KEYPUNCH INPUT

SEQUENCE NUMBER (001 - 999)		
EQUIPMENT TITLE (alphanumeric)		
P.W. BOARD TITLE (alphanumeric)		
BOARD LENGTH (xx.x inches)	BOARD SIZE	
BOARD WIDTH (xx.x inches)		
NUMBER OF WIRING LAYERS (1-9)		
CONNECTOR CODE (alphanumeric)	INPUT-OUTPUT	
CONTACTS USED (001 - 999)		
SIZE CODE (alpha)	COMPONENT NUMBER 1.	CIRCUIT COMPONENT MAKEUP
TYPE CODE (alpha)		
NUMBER USED (01-99)		
SIZE CODE (alpha)	COMPONENT NUMBER 2.	
TYPE CODE (alpha)		
NUMBER USED (01-99)		
SIZE CODE (alpha)	COMPONENT NUMBER 3.	
TYPE CODE 9 (alpha)		
NUMBER USED (01-99)		
SIZE CODE (alpha)	COMPONENT NUMBER 4.	
TYPE CODE (alpha)		
NUMBER USED		
SIZE CODE (alpha)	COMPONENT NUMBER 5.	
TYPE CODE (alpha)		
NUMBER USED (01-99)		
SIZE CODE (alpha)	COMPONENT NUMBER 6.	
TYPE CODE (alpha)		
NUMBER USED (01-99)		
SIZE CODE (alpha)	COMPONENT NUMBER 7.	
TYPE CODE (alpha)		
NUMBER USED (01-99)		
ANALOG-DIGITAL CODE (1-9) ROUTING CONSTANT NUMBER (1-9) BUSING CONSTANT NUMBER (1-9) GRID SIZE CODE NUMBER (1-9)	OTHER DETAILS	
REMARKS (alphanumeric columns 61-80)		

Figure 2-1

Table 2-2. Input-Output Code

Symbol	Spacing	Connector Type*	Connector Width
A	.100	29 2-part	3.0 inches
B	.156	15 one-sided	2.4
C	.156	22 one-sided	3.5
D	.156	44 two-sided	3.5
E	.125	60 two-sided	3.8
F	.150	23 2-part	3.5
G	.100	35 Elco	3.5
H	.100	105 Elco (3-tang)	10.5
J	.100	17 2-part	1.7
K	.100	86 two-sided	4.3
L	.200	32 two-sided	3.2
M	.200	44 two-sided	4.4
N	.200	100 two-sided	10.0
Ø	.156	72 two-sided	5.6
P	.156	10 one-sided	1.6
Q	.100	Discrete Contacts	@
R	.100	43 one-side	4.3
S	.156	36 two-sided	2.7
T	----	NOT PLUG-IN	---
U	.100	47 Elco (7023)	4.7
W	.156	18 one-sided	2.7
X	.125	86 two-sided	5.4
Y	.156	60 two-sided	4.7
Z	.156	30 two-sided	2.4
I	.100	56 two-part	2.8
0	.200	50 two-sided	5.0
1	.100	12 two-part	1.2
2	.200	18 two-part (perp.)	3.6
3	.100	4ea. 47 two-part	@
4	.156	28 one-sided	4.4
5	.156	50 two-sided	3.9
6	.125	136 two-sided	8.5
8	.125	16 one-sided	2.0
9	.125	24 two-part	3.0

* One-part, card-edge connector unless otherwise noted.
@ Assume connector width equals board width.

Columns 29-56	Circuit Component Makeup - seven groups of data to describe three basic features (physical size, type, and quantity) of the components on the printed wiring board.
Columns 29, 33, 37, 41, 45, 49, & 53.	Size code - one alphanumeric character to represent the physical size of a component. See Table 2-3 for details.
Columns 30. 34, 38, 42, 46, 50 & 54.	Type code - one alphanumeric character to represent the number of terminals on a component. See Table 2-4 for details.
Columns 31-32, 35-36, 39-40, 43-44, 47-48, 51-52, & 55-56.	Number used - total number of components on the board of the same physical size, 2-places, 99 maximum.
Column 57	Analog-Digital Code - A number to represent the type of circuitry on the board, especially from the viewpoint of degree of interconnection wiring difficulty. See Table 2-5 for details.
Column 58	Routing Constant - a number to represent restraints, if any, upon the routing of conductors on the wiring layers of the printed wiring board. See Table 2-6 for details.
Column 59	Busing Constant - a number to represent the conductors, if any on the printed wiring board that are wider than the conductor width associated with the grid spacing being used. See Table 2-7 for details.

Table 2-3. Size Code

Symbol	Component Size (S)
A	0.08 square inches
B	0.18 " "
C	0.30 " "
D	0.40 " "
E	0.50 " "
F	0.60 " "
G	0.70 " "
H	0.80 " "
I	0.90 " "
J	1.00 " "
K	1.25 " "
L	1.50 " "
M	1.75 " "
N	2.00 " "
Ø	0.03 " "
P	2.25 " "
Q	2.50 " "
R	0.05 " "
S	3.00 " "
T	4.00 " "
U	5.00 " "
V	7.50 " "
W	8.00 " "
X	10.00 " "
Y	15.00 " "
Z	20.00 " "

Table 2-4. Type Code

Symbol	Component Type (T)
A	1 terminal
B	2 terminals
C	3 "
D	4 "
E	5 "
	"
F	6 "
G	7 "
H	8 "
J	10 "
K	11 "
L	12 "
M	14 "
N	16 "
Ø	0 "
P	24 "
Q	68 "

EXAMPLES:

CM = 14-lead DIPs
BC = TO-5 can transistors
AC = TO-18 can transistors
ØB = RC06 resistors
RB = DO3 diodes and RC07 resistors
BM = 14-lead flatpacks

Table 2-5. Analog-Digital Code

0 = 1.0 (special circuits)
1 = 1.0(100% analog or simply wired circuits)
2 = 0.8
3 = 0.7
4 = 0.6
5 = 0.5
6 = 0.4
7 = 0.3
8 = 0.2
9 = 0.0 (circuits with complex interconnections)

Table 2-6. Routing Code

0 = no conductor routing restrictions.
1 = no conductors routed on layer #1.

2 = no conductors routed under any components on layer #1.
3 = no conductors routed between any component terminals - all layers.

4 = no conductors routed under any digital components on layer #1.
5 = no conductors routed between digital component terminals - all layers.

6 = no conductors routed under any analog components on layer #1.
7 = no conductors routed between analog component terminals - all layers.

Column 60

Grid Size Code - a number to represent the basic grid spacing being used on the printed wiring board. See Table 2-8 for details.

Table 2-7. Busing Constant

Symbol	Meaning
0	All conductors of same width
1	10% one grid size wider (1.1)
2	20% one grid size wider (1.2)
3	30% one grid size wider (1.3)
4	40% one grid size wider (1.4)
5	50% one grid size wider (1.5)
6	60% one grid size wider (1.6)
7	70% one grid size wider (1.7)
8	80% one grid size wider (1.8)
9	90% one grid size wider (1.9)

NOTE: A constant such as a "2" can also represent having 10% of the conductors two grid units larger in width.

Table 2-8. Grid Size Code

Symbol	Basic Grid Size
0	0.025-inch
1	0.050-inch
2	0.100-inch
3	0.200-inch

2.3 FAA CONTRACTORS

A letter, Figure 2-2, was sent to the FAA contractors listed in table 2-9 to afford them an opportunity to contribute data to the Printed Circuit Board Survey. The written responses to this solicitation are contained in Appendix C.

A meeting was held with FAA contractors on 11 September 1972 in San Francisco, California concurrent with the Institute of Printed Circuits Fall Meeting. At this time the objectives of the Survey were discussed and contacts made to facilitate the obtaining of information for the "Analysis" portion of the program. The following persons were in attendance:

Charles Andrasco, FAA Technical Officer
John McCormick, Rome Air Development Center
Gerald Ginsberg, Philco-Ford Program Manager
Julian Lieberman, Tasker Industries
R. R. Barta, IBM (Owego, New York)
E. A. Holub, IBM (Owego, New York)
G. C. Morse, Cinch Graphik
J. D. Bean, IBM (Owego, New York)
M. L. Suhr, Collins Radio (Cedar Rapids, Iowa)
Eugene Cooley, Collins Radio (Cedar Rapids, Iowa)
Foster L. Gray, Texas Instruments
Ivan R. Jones, Defense Electronics Supply Center
John Hanne, Texas Instruments
Bill Walter, Airesearch Manufacturing
Paul E. Twigg, IBM (Owego, New York)
Marvin Larsen, Bureau of Engraving
Dieter Bergman, Philco-Ford

A letter, Figure 2-3 was sent to FAA contractors of the equipment listed in Table 2-1. The letter included a questionaire, Figure 2-4 concerning the basic features of the equipment that are pertinent to the Comprehensive Analysis portion of the Printed Circuit Board Survey. The written responses to this solicitation are contained in Appendix D.

PHILCO Ford

Communications and Technical
Services Division
Philco-Ford Corporation

3900 Welsh Road
Willow Grove, Pennsylvania 19090

3 August 1972

Dear Sir:

The Communications and Technical Services Division of Philco-Ford has been awarded a contract (DOT FA7WA-3000) by the Federal Aviation Administration, entitled "Printed Circuit Board Survey".

The "SCOPE" of this program is to "analyze the present use of printed circuit boards" and to "establish standards for future control and application of printed circuit boards in F.A.A. electronic equipment".

The Survey includes a Study divided into two tasks, namely:

Task I - Analysis of existing FAA printed circuit boards.
Task II - Develop Standards for future equipment utilizing printed circuit cards.

Since you are presently listed as an active FAA contractor, we would like to offer you the opportunity to participate in the Study phase of the program.

A preliminary meeting will be held on Monday, September 11, 1972 at 1:30 P.M. at the Sheraton-Palace Hotel in San Francisco concurrent with the Institute of Printed Circuit's Fall Meeting.

If your company would like to avail itself of this opportunity, please contact me before the September 11th meeting. In the interim, it would be appreciated if you would sent me information concerning your printed wiring board design, fabrication, assembly, and testing procedures which you feel warrant consideration by the FAA under this program.

Sincerely,

G. L. Ginsberg
PCBS Program Manager

c.c.: C. Andrasco (FAA)

Figure 2-2

Table 2-9 (1 of 2). FAA Contractors

Acrodyne Industries, Commerce Drive, Montgomeryville, Pa.
Aerocom, 3090 SW 37th Avenue, Miami, Florida 33133
Airborne Instruments Lab, Deer Park, Long Island, N.Y.
Airesearch Mfg. 2525 W. 190th St., Torrance, California
Alden Electronics, Washington Street, Westboro, Mass. 01581
Ampex Corp., 101 Broadway, Redwood City, California 94064
Antenna Products, Box 9588, Austin, Texas 78757
ASC Systems 2060 N. Kolmar Avenue, Chicago, Illinois 60639
Astro Systems, 6 Nevada Drive, Lake Success, N.Y. 11040
Atlantic Research, Shirley H'way & Edsall Rd., Alexandria, Va.
Ault Inc., 3501 48th Avenue, Minneapolis, Minnesota 55429

Battelle Memorial Institute, Columbus, Ohio 43201
Bendix Field Engineering, 9250 Route 108, Columbia, Md.
Butler National, Mission, Kansas

Cardian Electronics, Long Island Expressway, Woodbury, L.I., N.Y.
Chain Lakes Research, 12850 Mansfield, Detroit, Michigan
Collins Radio, 5200 C. Avenue NE, Cedar Rapids, Iowa 52406
Communications Technology, 2237 Colby Ave., Los Angeles, Cal.
Computer Science, Falls Church, Virginia
Crescent Communications, 43 Hempstead, New London, Conn.

Ecolonics, Los Angeles, California
EDMAC Associates, 33 Canal Street, East Rochester, N.Y. 14068
Electronic Labs, 3726 Dacoma Street, Houstin, Texas 77018
Electronics and Manufacturing, Alexandria, Virginia

General Atronics, 1200 E. Mermail Lane, Philadelphia, Pa.
General Time, 1200 South Hicks, Rolling Meadow, Illinois
GRM Corporation, Medford, New Jersey
GTE Sylvania, Needham Heights, Massachusetts 02194

Hazeltine Corporation, Little Neck Parkway, Little Neck, N.Y.
Hewlett Packard 3215 Porter Drive, Palo Alto, California 94304
Hughes Aircraft, Box 3310, Building 609, Fullerton, California

Instruleck Corporation, 520 Homestead Ave., Mt. Vernon, N.Y.
International Microwave, 33 River Road, Cos Cob, Conn. 06807
ITI Electronics, 369 Lexington Avenue, Clifton, New Jersey
ITT Aerospace, 3700 E. Pontiac Street, Ft. Wayne, Indiana 46803
ITT Avionics, Essex and Nutley, New Jersey

Leach Corporation, 717 N. Coney Avenue, Azusa, California
Litton Industries, Walt Whitman Road, Melville, New York
Lockheed Electronics, Route 22, Plainfield, New Jersey
LTV Electrosystems, Dallas, Texas 75222

MEDRK Systems, Fort Walton Beach, Florida
Microwave Engineering, Concord, California
Multi-Electric 4223 West Lake Street, Chicago, Illinois

Nuclear Instruments, Milwaukee, Wisconsin 53209

Orbitronics, 3600 East 40th Avenue, Denver, Colorado

Progress Aerospace, 200 Windrim Avenue, Philadelphia, Pa.

Quindar Electronics, 60 Fadem Road, Springfield, New Jersey

Raven Industries, 205 East 6th Street, Sioux Falls, S.D. 57101
Raytheon Equipment, Boston Post Road, Wayland, Mass. 01778

Saturn Electronics, Box 112, Grand Island, New York 14606
Scanwell Labs, 6400 Scanwell Lane, Springfield, Virginia
Scientific Radio Systems, 367 Orchard St., Rochester, N.Y. 14467
Solid State Radiations, 2261 S. Carmelina Ave., Los Angeles, Cal.
Struthers Electronics, Mamaroneck, New York 10453
Systems Control Incorporated, Palo Alto, California

Tasker Industries, 20131 Sunburst Street, Chatsworth, Cal.
Tektronix Incorporated, Box 500, Beaverton, Oregon 97005
Telectro Systems, 96-18 43rd Avenue, Corona, New York
Telemodem Inc., 98-05 217th Street, Queens Village, New York
Telline Radio Incorporated, Arlington, Virginia
Texas Instruments, Box 5303, Dallas, Texas

United Telecontrol Electronics, 3500 Sunset, Asbury Park, N.Y.
Univac Defense Systems, Univac Park, St. Paul, Minnesota
Univac Federal Systems, Box 3525, Univac Park, St. Paul, Minn.

Virginia Electronics, 2901 Telestar CT, Falls Church, Virginia
Vitrol Labs, 14000 Georgia Avenue, Silver Springs, Maryland

Westinghouse Electric, Box 746, Baltimore, Maryland 21203
Wilcox Electronics, 14th and Chestnut Streets, Kansas City, Mo.

PHILCO Ford

Communications and Technical
Services Division
Philco-Ford Corporation

3900 Welsh Road
Willow Grove, Pennsylvania 19090

October 13, 1972

Dear Sir:

The Communications and Technical Services Division of Philco-Ford has been awarded a contract (DOT FA7WA-3000), "Printed Circuit Board Survey", by the Federal Aviation Administration. This survey includes: Task I - Analysis of existing FAA printed circuit boards (PCB's) and Task II - Develop Standards for equipment utilizing PCB's.

Since you have provided equipment, which is to be analyzed, we are soliciting your voluntary input for the Task I Analysis. The effect on equipment design, manufacturing, maintenance, and performance, if a printed circuit board size restriction of 3 x 4-1/2 inches maximum (connector or tang on 3 inch side), had been imposed on the equipment vendor at the time of procurement, must be determined.

Our intent is to have your people, who have knowledge of the equipment, complete the enclosed questionaire. No involved investigation or cost analysis is intended, but judgement information with minimal "digging" or analysis is desired. Where costs are involved, an approximate plus or minus percentage cost change is preferred to absolute dollar values. The background information requested will also aid us in determining the effect of imposing such a board size restriction.

We would welcome any other comments concerning this standardization effort, which will culminate in the development of a Standard for printed circuit boards and their application suitable for use by the FAA in future procurements.

Sincerely,

Donald L. Ware

Donald L. Ware
Senior Engineering Specialist
Advanced Systems and Technology

cc: C. Andrasco (FAA)
G. Ginsberg - Program Manager (Philco-Ford)

Figure 2-3

Date Completed _____

QUESTIONAIRE

EQUIPMENT: _____

VENDOR: _____

(Use additional sheets if required.)

BACKGROUND INFORMATION

1. What specifications were originally envoked which directly affected P.C. board size?

2. What other specifications or equipment requirement affected P.C. board size?

3. To what extent did the utilization of maximum equipment cabinet volume influence P. C. board size?

4. Were vendor Standards used for P.C. board sizes?

5. What factors were dominant in P.C. board size determination?

6. What specifications or other requirements affected P.C. board connector selection?

7. Were the equipment and/or P.C. boards "off-the-shelf"?

8. Was any new tooling (fabrication and/or test) required for these P.C. boards?

9. What was the approximate quantity of P.C. boards (by type) in the first procurement?

Figure 2-4
Page 1 of 2

Design and Documentation

P.C. Board (Partitioning, layout, backpanel)

Equipment (Interconnections, card rack)

Manufacturing

Material (Laminate, connectors, card rack, backpanel cabinets)

Fabrication (Board blank, auto insertion, backpanel)

Test (Interface, fault isolation, facility complexity)

Maintenance

Troubleshoot and Repair (Fault isolation to a P.C.B., to a component)

Logistics (Spares reprocurement)

Performance

Electrical (Consistency and absolute)

Mechanical (Ruggedness)

Reliability (Number and types of interconnections)

Figure 2-4
Page 2 of 2

APPENDIX A

FAA EQUIPMENT

Equipment:	Radar Brite Display Equipment
Nomenclature:	RBDE-5
FAA Type:	FA-2449
Contractor:	Raytheon, Lexington, Mass.
Contract:	30 June 1961

FROM FAA LIBRARY INSTRUCTION BOOK (7 July 1972):

FA-7500	Control Rack Assembly Group
FA-7501	Control Rack Assembly (CRA) - figure 11-1 photo
FA-7524	Unit 1. (Inner Front View) - figure 11-2 photo
FA-7510	TV Video Mixer Assembly - figure 11-3 photo w/ (18) PB1 and (1) PB47 extender board
FA-7516	Unit 1. (Front View) w/ (8) Symbol Generators - photo w/ (1 each) PB2, 4, 5, 6, 7 and (4 each) PB3 and 8
FA-7509	(2) Isolation Amplifiers - photo w/ (1 each) PB13 and (5 each) PB12
FA-7524	CRA (Rear View) - figure 11-11 photo w/ (8) Symbol Generators - see above FA-7516, w/ (1) Horizontal Sync Distributor, and w/ (1) Vertical Sync Distributor
FA-7511	Horizontal Sync Distributor - figure 11-12 photo w/ (13) PB11
FA-7528	Vertical Sync Distributor - figure 11-13 photo w/ (11) PB11 and (1) PB47 extender board
FA-7525	Unit 2. (Rear View) - figure 11-30 photo w/ (3) Joystick Stotage Units, (1) Origin Commutator, w/ (1) Channel A Arithmetic Unit, and w/ (1) Channel A Antenna Position Counter
FA-7512	Joystick Storage Unit - figure 11-31 photo w/ (5 each) PB14, 17, 18; (4) PB15; (10) PB10; (11) PB16
FA-7515	Arithmetic Unit (A & B) - figure 11-33 photo w/ (1) PB41, (2) PB36, (3) PB39, (17) PB40, (19) PB46
FA-7526	Origin Commutator - figure 11-32 photo w/ (1 each) PB14, 15, 17, 18; (2 each) PB10, 16; (11) PB19

Antenna Position Counter (A & B) - figure 11-34 photo
w/ (1 each) PB34, 39, 41, 42, 45; (2) PB44; (3) PB35

FA-7525 CRA - Unit 2. (Inner Rear View) - figure 11-36 photo
w/ (1) Channel A Sync & Grating Generator
w/ (1) Channel B Sync & Grating Generator
w/ (1) Channel B Arithmetic Unit, and
w/ (1) Channel B Antenna Position Counter.

FA-7514 Sync & Grating Generator (A & B) - figure 11-37 photo
w/ (1 each) PB21, 22, 24, 25, 26, 27, 29, 31, 33, 48, 50, 51;
w/ (2 each) PB23, 28, 30, 35, 49; (4) PB32;and (5) PB20.

FA-7531 Scan Converter - figure 11-39 photo
w/ (1) Write Video Assembly,
w/ (1) Write Deflection Assembly,
w/ (1) Read Deflection Assembly, and
w/ (1) Resolver & Focus Assembly

FA-7546 SC Write Video Assembly - figure 11-54 photo
w/ (1 each) PB79, 84, 85, 86, 87, 88, 95, 96 and (2) PB94

FA-7540 SC Write Deflection Assembly - figure 11-57 photo
w/ (1 each) PB70, 71, 72, 90, 92 and (2 each) PB89, 91.

FA-7542 SC Read Deflection Assembly - figure 11-58 photo
w/ (1 each) PB77, 78, 80, 81, 82, 83 and 89.

FA-7547 SC Resolver & Focus Assembly - figure 11-59 photo
w/ (1 each) PB 73, 75, 76 and (2 each) PB74, 93

FA-7531 SCFA (Rear View)- figure 11-61 photo
w/ (1) Range Marks & Beacon Trigger Generator

Range Marks & Beacon Trigger Generator - figure 11-64 photo
w/ (1 each) PB39, 41, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69 and (4) PB44

FA-7561 SCFA (Rear Side View) - figure 11-111 photo
w/ (1 each) PB 151 and 152.

FA-7561 SCFA (Rear View) - figure 11-113 photo
w/ (1 each) PB111, 112, 114, 115, 117, 118, 119, 120, 151, and 152

Section 6.	Preventive Maintenance	
	6-1	Daily
	6-2	Weekly
	6-3	Monthly
	6-4	Quarterly
	6-5	Semi-Annually
Section 7.	Corrective Maintenance	
	1.3	PB Repairs

FROM OKLAHOMA CITY (24 JULY 1972):

Board Size:	* 5-inches wide by 6-inches long by 1/16-inch thick
Board Type:	Single-sided and Double-sided
Connector:	AMP (Blade) 3.582152.3 29-contacts on 0.1-inch centers
Photographs:	101 photographs were taken of all 100 different board designs, including photographs of both the component side and circuit side of PB-6. (PB1-36, 40-42, 44-51, 60-96, 110-115, 117-121, 131, 133, 134, 151, 152 inclusive)

* Note: PB121 is 4.2-inches long by 5.0-inches wide.

Equipment:	Test Monitor Control Equipment
Nomenclature:	RTC-3
Basic FAA Type:	FA-6400
Vendor:	Raytheon (Wayland, Mass.)
Contract:	FA64WA-5002 (June 29, 1964)

FROM FAA LIBRARY INSTRUCTION BOOK (7 July 1972):

Volume III	Section 11.
Fig. 163	Monitor Alarm Card 91000 Double-sided printed wiring board w/ 44-pin card-edge connector - contacts on 0.156-inch centers. (Scale - 1:1) Size: width= 4.8-inches, length= 7.4-inches
Fig. 164	Monitor Identity Card 92000 Single-sided printed wiring board
Figs. 174 thru 187 inclusive	Double-sided printed wiring boards w/ 44-pin card-edge connector - contacts on 0.156-inch centers. (Scale - approximately 9:10) DIP circuit components. Size: width= 5.2-inches, length= 6.0-inches
Figs. 205-225	Printed Wiring Board Assemblies

FROM OKLAHOMA CITY (26 July 1972):

FA-6402	Azimuth Transponder Monitor Photographs of 10 boards of type described above for "Figs 174 thru 187 inclusive".
FA-6403	Adjacent Channel Signal Generator Photographs of 10 boards of type described above for "Figs 174 thru 187 inclusive".
FA-6404	Test Pulse Marker Generator Photographs of 4 boards of type described above for "Figs. 174 thru 187 inclusive".
FA-6405	Monitor Power Supply Photographs of 3 single-sided boards, 4.3-inches wide, 3.3-inches long, with 15 card-edge contacts on 0.156-inch centers
FA-6415	Audio Oscillator Photographs of 1 double-sided board, 7-inches wide, 10.5-inches long, with 44 card-edge contacts on 0.156-inch centers.

Equipment:	Air Traffic Control Beacon Ground Station Video Defruiting Equipment Group
Nomenclature:	ATCBI-3
Basic FAA Type:	FA-7200
Vendor:	Whitaker Corporation (North Hollywood, Cal.)
Contract:	FA-957 (July 11, 1960)

FROM FAA LIBRARY INSTRUCTION BOOK (7 July 1972):

Volume One	Fig. 11-17	Regulation & Input Circuits w/20-pin card-edge connector
	Figs. 11-16/21 inclusive	Printed Wiring Board Assemblies

FROM OKLAHOMA CITY (26 JULY 1972): ATCBI-4

Board Size:	4-inches wide by 2.5-inches long by 1/16-inch thick
Board Type:	Double-sided
Connector:	Card-Edge (one-part) 60-contacts on 0.125-inch centers
Photographs:	Photographs were taken of 17 different board designs. (09017 Assy 707075, 077, 079, 082, 096, 098, 235, 237, 239, 241, 243, 245, 247, 249, 253, 255, and 314.)

Equipment:	ATCBI-3 Storage Tube Defruiter
Nomenclature:	none
Basic FAA Type:	FA-7280
Contractor:	Airborne Instruments Lab Deer Park, Long Island, New York
Contract:	FA-WA-5229

FROM OKLAHOMA CITY (26 July 1972):

FA-7283	Comparator Card Block 4300	(1 per system)
FA-7284	Amplifier Driver Card Block 4500	(3 per system)
FA-7285	Sweep Card Block 4700	(1 per system)

Photographs:	Photographs were taken of 3 different printed wiring board designs.
Board Size:	11.8-inches long, 8.3-inches wide
Connector:	U.S. Components (Pin and Socket w/shell) UPCC-M23B - 23-pin

Equipment:	Bright Radar Indicator Tower Equipment
Nomenclature:	BRITE-1
Basic FAA Type:	FA-7847
Vendor:	ITT Industrial Labs Division Fort Wayne, Indiana 46803
Contract:	FA67WA-1965 (Feb. 24, 1967)

FROM FAA LIBRARY INSTRUCTION BOOK TI 6310.2 (7 July 1972):

Volume 2.	Figs. 11-13/38 inclusive	Printed Wiring Board Photographs

FROM OKLAHOMA CITY (25 July 1972):

FA-7852	Display Made by Atlantic Technology Corporation, Somers Point, New Jersey
FA-7581	Camera Made by Diamond Power Specialty Corporation, Lancaster, Ohio
FA-7849	Remote Control Unit

Equipment:	Runway Visual Range System
Nomenclature:	RVR
Basic FAA Type:	FA-7861
Contractor:	Solid State Radiations, Incorporated Los Angeles, California 90064
Contract:	FA67WA-1827 (5 July 1967)

FROM OKLAHOMA CITY (27 July 1972):

FA-7871	Signal Data Converter
FA-7872	Control & Power Supply
FA-7873	Receiver Decoder
FA-7874	Computer Selector
Board Size:	Signal Data Converter 4.5-inches wide by 5.3-inches long and 15-inches wide by 5.6-inches long. Control & Power Supply 4.5-inches wide by 5.3 inches long. Receiver Decoder 4.5-inches wide by 5.3 inches long.
Connector:	Elco Varicon #42 6035 10 35 contacts
Photographs:	Photographs were taken of 17 different printed wiring board designs. (12-Signal Data Converter, 1-Control & Power Supply, 4-Receiver Decoder)

FROM FAA LIBRARY (2 November 1972):

Volume I.	
Volume II.	Figures 11-19 thru 11-44 photographs of 26 printed wiring board designs, M01 thru M26.
Volume III.	7868 Transmissometer

Equipment:	Computer Display Channel, Computer Update Equipment, Non-Radar Keyboard Multiplexer
Nomenclature:	CDC and CUE
Basic FAA Type:	FA-7900 and FA-7919
Vendor:	Raytheon, Lexington, Mass.
Contract:	FA 67NS-27 (31 Jan 67)

FROM FAA LIBRARY INSTRUCTION BOOK (7 July 1972): FA-7919
VOLUME III - PHOTOGRAPHS & MECHANICAL DRAWINGS

Fig. 11-4	NRKM
	Photographs & layouts of plug-in printed wiring boards with card-edge connectors. Double-sided, with 44-pin connectors, 0.200-inch centers. (Scale: 78% of actual size) Size: width= 5.2 inches, length= 6.5 inches
Fig. 11-18	Power Regulator A4A3A1 (PW)
Fig. 11-19	Full Wave Detector
Fig. 11-20	Overvoltage/Undervoltage Detector
Fig. 11-21	Undervoltage Detector
Fig. 11-22	State Ripple Ctr.
Fig. 11-23	Output Signal
Fig. 11-31	Short Line Terminator (Cordwood Module)
Fig. 11-32	Voltage Plane Filter (Cordwood Module)
Fig. 11-33	Square Wave Oscillator
Figs. 11-34/35	Memory Unit
	P.W. Boards with 15-pin Elco connectors
Fig. 11-41	5 Volt Regulator
Fig. 11-42	Strobe Driver
Fig. 11-43	Sense-Amplifier - Data Regulator
Fig. 11-44	6 Volt Regulator
Fig. 11-52	Memory Power Supply

CDC/CUE

Fig. 11-58	Temperature Monitor Printed Wiring board with 35-pin, two-part, discrete blade connector on 0.100 inch centers. (Scale: 1 to 1, approximately); (2) 14-lead DIPs plus discrete components. Board Size: width= 3.8 inches, length= 3.4 inches
	Photographs and layouts of plug-in printed wiring boards with card-edge connectors. Double-sided, with 60-pin connectors, 0.100-inch centers. (Scale: 78% of actual size) Size: width= 3.3 inches, length= 5.4 inches
Figs. 11-61/72	CLU I-O (w/ (7) DIPs)
Fig. 11-62	I/O Logic No. 1.
Fig. 11-63	I/O Logic No. 2
Fig. 11-64	I/O Logic No. 3
Fig. 11-65	DC Power Monitor
Fig. 11-66	SMMC Driver
Fig. 11-73	I/O Logic No. 4
Fig. 11-74	I/O Logic No. 5
Fig. 11-75	Reconfig. Memory Unit

FROM FAA LIBRARY INSTRUCTION BOOK (7 July 1972): FA-7900

Figure 4-4	Diode Matrix Lamp Driver A3 (Component Side View) (2/3 actual size) Double-sided printed wiring 44-pin card-edge connector - 0.200-inch centers Board Size: width=5.3 inches, length=6.2 inches Circuit Components: (2) 14-lead DIPs, (32) diodes, (3) capacitors, (14) resistors, and (5) test points.

FROM OKLAHOMA CITY (27 July 1972):

Photographs were taken of 119 different board designs. (8 boards specifically designated as being from CUE were 3.6 wide, 5.6 long, with 60-pin 0.1-inch spacing card-edge contacts.)

Equipment:	Coded Time Source
Nomenclature:	none
Basic FAA Type:	FA-7951
Contractor:	Electronic Labs Incorporated Houston, Texas

FROM OKLAHOMA CITY (27 July 1972):

FA-7955	Audio Tape Time Display Unit
	DCL Test Jack Panel
	Counting Logic Indicator Panel
	Error Detection & Switch-over
Board Size:	4.5-inches wide by 4.1 inches long by 1/16-inch thick
Board Type:	Double-sided
Connector:	Card-edge (one-part) 44 contacts on 0.156-inc centers
Photographs:	Photographs were taken of 36 different board designs.

Equipment:	Localizer Station (Instrument Landing System)
Nomenclature:	Mark IA
Basic FAA Type:	FA-8000
Vendor:	Wilcox (An American-Standard Company) Kansas City, Missouri
Contract:	FA68WA-1890 (April 30, 1968)

FROM FAA LIBRARY INSTRUCTION BOOK TI 16750.11-.19 (7 July 1972):

T16750.12	Transmitter (Localizer & Glide Slope)	
	No printed wiring boards.	
T16750.13	Modulator	
	Fig. 11-11:	Power Supply Card Assembly
T16750.14	Monitor (Layouts w/ 12-lead "TO" cans)	
	Figs. 11-4/12-2	Alarm Assembly
	Figs. 11-5/12-1	Audio Assembly
	Figs. 11-6/12-4	Power Supply Assembly
	Fig. 11-7	Localizer Monitor Ident.
	Fig. 12-3	Ident. P. C. Board
T16750.15	Control Unit	
	Figs. 11-5/12-2	Localizer Control
	Figs. 11-6/12-1	Glide Slope Control
T16750.16	Changeover Unit	
	No printed wiring boards.	
T16750.17	Antenna	
	No printed wiring boards.	
T16750.18	Monitor Detector	
	No printed wiring boards.	
T16750.19	Keyer	
	Figs. 11-5/12-1	Clock Assembly
	Figs. 11-6/12-2	Sequencer Assembly
	Figs. 11-7/12-3	DME Switch & Voltage Regulator
	Figs. 11-8/12-4	Code Selector
	Figs. 11-9/12-5	Tone Oscillator-Dash Generator

FROM OKLAHOMA CITY (26 July 1972):

FA-8005	Localizer
FA-8023	Glide Slope
	Capture Effect

Photographs: Photographs were taken of 22 different board types.

Equipment:	Video Mapper
Nomenclature:	none
Basic FAA Type:	FA-8049
Vendor:	Texas Instruments, Dallas, Texas
Contract:	FA-69WA-2081 (31 March 1969)

FROM OKLAHOMA CITY (26 July 1972):

Mapper Module	(7) Printed Wiring Board designs- 4.8-inches wide, 8.4-inches long 29-pin Elco 7023 Varicon connector
Distribution Amplifier	(2) Printed Wiring Board designs- 6.8-inches wide, 8.0-inches long 47-pin Elco 7023 Varicon connector
Azimuth Processor	Made by Natel Engineering Company (9) Printed Wiring Board designs- 8.0-inches wide, 6.5-inches long 47-pin Elco 7023 Varicon connector
Power Supply	(4) Printed Wiring Board designs- 6.0-inches wide, 4.0-inches long 35-pin Elco 7023 Varicon connector
Photographs:	Photographs were taken of all 22 different printed wiring board designs.

FROM FAA LIBRARY (2 November 1972):

Volume I.	Sections 1-11 (Section 11 - Figures 11-7 thru 11-19 not inclusive, printed wiring layouts)
Volume II.	Section 12.

Equipment:	Beacon Video Defruiting Equipment (Storage Tube)
Nomenclature:	None
Basic FAA Type:	FA-8100
Vendor:	Cutler-Hammer Deer Park, New York 11729
Contract:	DOT-FA69WA-2047 (Nov. 27, 1968) DOT-FA69WA-2206 (June 30, 1969)

FROM FAA LIBRARY INSTRUCTION BOOK TI-6360.5A (7 July 1972):

Volume III	Fig. 11-11	Sweep Card
	Figs. 11-11/18	Printed Wiring Boards

FROM OKLAHOMA CITY (26 July 1972):

Equipment:	Solid State Defruiter
Nomenclature:	MX-8757/UPX (Navy)
Contractor:	Cardion Electronics Woodbury, Long Island, New York
Board Size:	7.8-inches wide, 3.3-inches long
Board Type:	Double-sided
Connector:	Card-edge (One-part) with 44-contacts on 0.156-inch centers.
Photographs:	Photographs were taken of 8 different board designs. (101496, 101497, 101498 010499, 101501, 101502, 101503, and 101504)

Equipment:	Doppler VOR Sideband Antenna Monitor
Nomenclature:	None
Basic FAA Type:	FA-8142
Vendor:	Chain Lakes Research Corporation 12850 Mansfield Detroit, Michigan 48227
Contract:	DOT-FA69WA-2070 (29 Jan 1969)

FROM FAA LIBRARY INSTRUCTION BOOK TI 6790.2 (7 July 1972):

Fig. 14	Monitor Unit w/Front Door Open - photo
Fig. 17	A101 Power Supply - layout
Fig. 18	A201 Input Amplifier - layout
Fig. 19	A301 Output Amplifier - layout
Fig. 20	A401 Alarm Circuits - layout
Fig. 21	A501 Auxiliary Power Supply - layout

FROM OKLAHOMA CITY (26 July 1972):

Board Size:	PC1-4 inclusive: 5.0-inches wide, 5.0-inches long PC5: 5.0-inches wide, 2.5-inches long
Board Type:	Single-sided
Connector:	Card-edge (one-part) 15 contacts on 0.156-inch centers.
Photographs:	Photographs were taken of 5 different printed wiring board designs. (PC1-5 inclusive)

Equipment:	5 Channel Recorder
Nomenclature:	none
Basic FAA Type:	FA-8144
Contractor:	Leach Corporation (Azusa, California)
Contract:	DOT-FA69WA-2116

FROM OKLAHOMA CITY (27 July 1972):

Board Size:	4.9-inches wide by 5.1-inches long Transfer Control Logic 8.0-inches wide by 8.0-inches long Power Supply 4.5-inches wide by 2.5-inches long
Board Type:	Single-sided printed wiring except for double-sided Transfer Control Logic board.
Connector:	Card-edge (one-part) - 0.156-inch centers 18 contacts except for Transfer Control Logic (86 contacts) and Power Supply (15 contacts)
Photographs:	Photographs were taken of 11 different board designs. (8-Basic Equipment, 1-Transfer Logic & Control, 2-Power Supply)

Equipment:	Airport Surveillance Radar Display System
Nomenclature:	ASRDS-3
Basic FAA Type:	FA-8150
Vendor:	ITT (Aerospace/Optical Division) Fort Wayne, Indiana 46803
Contract:	DOT FA69WA-2030 (Nov. 8, 1968)

FROM FAA LIBRARY INSTRUCTION BOOK T-I-6310.5 (7 July 1972):

Volume I-	Section 1.: General Description Section 6.: Preventive Maintenance Section 7.: Corrective Maintenance
Volume II-	Section 11.: Photographs & Mechanical Drawings Figures 11-27 thru 11-56 inclusive Printed Wiring Boards w/ card-edge connectors and DIP components. (Scale: 5:6) 44-pin connector w/contacts on 0.156-inch centers. Both sides shown. Size: width= 4.5-inches, length= 6.4-inches

FROM OKLAHOMA CITY (26 July 1972):

Board Details:	As described above.
Photographs:	Photographs were taken of 22 different board designs. (10-Common Equipment, 12-Indicator)

FROM FAA LIBRARY (7 July 72)

Equipment:	Radio Channel Control Equipment
Nomenclature:	None
Basic FAA Type:	FA-8165
Vendor:	GRM Corporation (Medford, N. J.)
Contract:	DOT-FA69WA-2178 (June 3, 1969)
Source:	Preliminary Instruction Book (TI 6650.18)

Section 1.:	General Description
Section 6.:	Preventive Maintenance
Section 7.:	Corrective Maintenance
Section 11.:	Photographs
	Non-plug-in Printed Wiring Boards Scale: approximately 2.1:1 Size: width= 2.6-inches, length= 6.4 inches
Fig. 11-5	Lamp Brightener Module - photo
Fig. 11-6	Volume Control Module - photo
Fig. 11-7	Recorder Mixer Monitor Module - photo
Fig. 12-22	Lamp Brightener Module - plan view
Fig. 12-23	Volume Control Module - plan view
Fig. 12-24	Recorder Mixer Monitor Module - plan view

Equipment:	Bright Radar Indicator Tower Equipment
Nomenclature:	BRITE-2
Basic FAA Type:	FA-8178
Contractor:	ITT Aerospace/Optical Division (Ft. Wayne, Indiana)
Contract:	FA69WA-2209

FROM FAA LIBRARY INSTRUCTION BOOK TI 6410.3A (7 July 1972):

Volume 1.	Pages 1-2 and 1-3, Figure A - xxxiii Section 7. Corrective Maintenance Figs. 7-1/34 inclusive
Volume 2.	Section 11. - Photographs of equipment/boards Figs. 11-25/11-65 Printed Wiring Boards & artwork
(1) FA-8179	PPI Unit - ITT Aerospace/Optical Division Plan Position Indicator w/photos of equipment and printed wiring boards, #A1/A23 - conventional components/card-edge connectors.
(2) FA-8180	Remote Control Unit (RCU) - ITT Aerospace/Optical Division - little or no detail on small printed wiring boards.
(1) FA-8181	TV Display - complete photographs of equipment/boards. Card nest w/ printed wiring boards A1/A6 inclusive. Hand soldered connectors-no backpan.
(1) FA-8182	TV Camera - complete photographs of equipment/boards. (Diamond model ST-3V) DIP components. Fig. 11-50 Video Amp Module (1A2A2) Fig. 11-51 EIA Sync Module (1A2A3) Fig. 11-52 Sync Generator Module (1A2A4) Fig. 11-53 Vertical Deflection Module (1A2A5) Fig. 11-54 Low Voltage Module (1A2A6) High Voltage Module (1A2A7)
(1) FA-8183	Line Voltage Regulator (LVR) - no information on printed wiring boards.

FROM OKLAHOMA CITY (25 July 1972):

Display:	Made by Atlantic Technology Corporation, Somers Point, New Jersey
TV Camera:	Made by Diamond Power Specialty Corporation, Lancaster, Ohio
Board Size:	Display (A1-6 inclusive): 9.0-inches wide, 6.1-inches long Camera (w/metal end brackets): 4.1-inches wide, 6.8- and 10.1-inches long PPI: 4.5-inches wide, 6.3- and 3.8-inches long
Board Type:	Double-sided and single-sided
Connector:	Card-edge (one-part)- 0.156-inch centers Display- 36 contacts Camera - 18 contacts PPI - 44 contacts
Photographs:	Photographs were taken of 32 different board designs. (4-Display, 6-Camera, 22-PPI)

Equipment:	Back-Up Emergency Communications
Nomenclature:	BUEC
Basic FAA Type:	FA-8195
Contractor:	ITT Aerospace/Optical Division Ft. Wayne, Indiana
Contract:	DOT-FA70WA-2288

FROM OKLAHOMA CITY (28 July 1972):

Remote Control Processor	6.8-inches wide, 6.8-inches long, double-sided printed wiring boards with 72 card-edge contacts on 0.156-inch centers.
VHF Trasceiver (20 Watt) FA-8191	4.0-inches wide, 4.3-inches long, single-sided printed wiring boards with 15 card-edge contacts on 0.156-inch centers.
	7.0-inches wide, 1.6-inches long, double-sided printed wiring boards with Elco Varicon contacts on 0.125-inch centers.
	VHF Transceiver Control Adapter double-sided printed wiring board, 10.0-inches wide, 6.6-inches long with 44 card-edge contacts on 0.156-inch centers.
Remote Link Tester FA-8763	Double-sided printed wiring boards with card-edge connector contacts on 0.156-inch spacing; 8-inches wide by 8-inches long with 60 contacts; 6.8-inches wide by 6.4-inches long with 72 contacts; and 4.6-inches wide by 6.4-inches long with 44 contacts.
Priority Module	Double-sided printed wiring board, 14-inches long, 7.8-inches wide, with 60 card-edge contacts on 0.156-centers.
Photographs:	Photographs were taken of 22 different printed wiring board designs. (7-Remote Control Processor, 11-VHF Transceiver, 3-Remote Link Tester, 1-Priority Module)

Equipment:	Automated Radar Terminal System
Nomenclature:	ARTS-III
Basic FAA Type:	FA-8300
Contractor:	Univac Defense Systems Division St. Paul, Minnesota 55165

FROM FAA LIBRARY (7 July 1972):

Volume 1. (PX 5899-1-2)		Data Processing Subsystem (DPS)
Section 3.	Maintenance	
Section 4.	P. C. Modules	
	Figs. 4-1/4-22 inclusive	P. C. Boards w/flatpack components and Fabritek 56-pin two-part connectors p/n 200125-01
(PX 5898-0-2)		D. P. S. Power Supply
Section 4.	P. C. Modules	w/flatpack components
	Figs. 4-1, 4-2, 4-3, 4-4, 4-5, 5-4, 5-5, and 5-11	
(PX 5896-1-2)	D. P. S. Input/Output Processor (IOP)	
	Figs. 4-1/4-40 inclusive	
(PX 5895-0-2)	D. P. S.	General
S 365-58	Magnetic Tape Transport (Potter Instrument)	
	Fig. 15	Transport Control Module
(PX5897-1-2)	Memory Unit - pages 4-1/14, 5-18, 23, 28, 31, 36, 39	
	Memory: card-edge connectors, integrated circuits and discrete components. (1) MTC, (1)UCM, (1)CSM, (8)ADS, (16)DCM 1, (16)DCM 2.	
	Multiplexer: Univac 2-part connector and discrete components (1)A, (4)B, (4)C, (12)D, (1)E, (2)F.	
(PX6213)	General System Manual Beacon Tracking Level System	

Basic Subsystem- Data Processing Subsystem (DPS)
Data Acquisition Subsystem (DAS)
Data Entry & Display Subsystem (DEDS)

Assume Single-Beacon System (there are also Duals)

GFE- Comm. Modem, Beacon Interrogator, and Surveillance Radar

Univac - Data Processing Subsystem
- Interfacility Communication Adapters
- Input/Output Processor
- Memory
- Tape Controller & Transport
- Typewriters & Adapter

Peripheral Equipment - Optional
- Uniservo VIC Tape Units
- 9300 Card Processor

Data Acquisition Subsystem -
- Beacon Control Unit
- Azimuth Pulse Generator
- Data Acquisition Subsystem

Data Entry & Display Subsystem -
- Digital Sweep Generator (Standby & Normal)
- Display (Up to 10 per system)
- Data Entry Set (Up to 3 per display)

FROM OKLAHOMA CITY (25 July 1972):

Board Types: Single-sided, double-sided, and multilayer.

Photographs: Photographs were taken of 153 different printed wiring board designs.

ARTS-III

Equipment:	Automated Radar Terminal System, Data Entry Display Subsystem
Nomenclature:	ARTS-III
Basic FAA Type:	FA-8300
Vendor:	Texas Instruments (Dallas, Texas)
Contract:	DOT FA69WA-2071

FROM FAA LIBRARY INSTRUCTION BOOK (7 July 1972):

Figs. 11-8, 9, 12, 14/15, 57, 63, 65, and 67 inclusive.

Equipment:	Airport Surveillance Radar
Nomenclature:	Model ASR-4
Basic FAA Type:	FA-4700
Source:	Instruction Manual (TI 6310.6)
Volume 1.	Figs. 11-7/13 inclusive

Equipment:	ARSDS 1
Basic FAA Type:	FA-7300 and FA-7700
Source:	Instruction Manual (T 6310.7)
Volume 1.	Figs. 11-7/13 inclusive

Equipment:	Data Acquisition Subsystem
Nomenclature:	DAS-4
Basic FAA Type:	
Vendor:	Burroughs
Figs 4/28 inclusive	Illustrated Parts Breakdown

Equipment:	Radar Bright Display Equipment (Control Rack Assembly)
Nomenclature:	RBDE-6
Basic FAA Type:	FA-8400
Vendor:	Westinghouse Electric Baltimore, Maryland
Contract:	FA 70WA-2262 (Dec. 15, 1970)

FROM FAA LIBRARY INSTRUCTION BOOK (7 July 1972):

Fig. 11-4	TV Video Mixer Assembly - layout
Fig. 11-5	Video Distr. Amplifier Assembly
Figs. 11-14/31 inclusive	Printed Wiring Board Assemblies

RBDE

Pages 1-3, 11-6/13, 11-18, and 11-19 inclusive

(A1) Beacon Video Cabinet - no printed wiring

(A2) TV Video Cabinet
pages 11-6, 7, and 8: P.W. Board Number List
pages 11-10 and 11: P.W. Bd. component layout

(A3) P.S. & Monitor Cabinet - no printed wiring

(A4) Synchronizer & Control Cabinet
pages 11-20, 21, 26, 28/49 inclusive

(A5) Scan Converter Remote Control Cabinet - no printed wiring boards - patch panels.

FROM OKLAHOMA CITY (25 July 1972):

Board Type:	Double-sided printed wiring
Board Size:	Scan Converter: (Plug-in) 6.3-inches long, 7.0-inches wide Horizontal Display: (Non-plu-in) 9-inches wide, 12-inches long
Connector:	Scan Converter: Card-edge (one-part) 36-pin. 0.156-inch centers.
Photographs:	Photographs were taken of 17 different board designs. (14 Scan Converter, 3-Horizontal Display)

Equipment:	Instrument Landing System
Nomenclature:	Mark IB
Basic FAA Type:	FA-8610
Contractor:	Cutler Hammer
Contract:	FA69WA-2196

FROM OKLAHOMA CITY (26 July 1972)

Photographs:	Photographs were taken of 14 different board designs.

Equipment:	50-Watt VHF/UHF Transmitters
Nomenclature:	None
Basic FAA Type:	TV-36 and TU-9
Vendor:	Collins Radio (Cedar Rapids, Iowa)
Contract:	FA64WA-5251

FROM FAA LIBRARY INSTRUCTION BOOK (7 July 1972):

Section 1.:	General Description
Section 6.:	Preventive Maintenance
Section 7.:	Corrective Maintenance
Section 11.:	Photographs & Mechanical Drawings

FROM OKLAHOMA CITY (28 July 1972):

TV-36	No plug-in printed wiring boards.

Equipment:	VHF 8-Watt Transmitter
Nomenclature:	None
Basic FAA Type:	TV-35
Vendor:	Wilcox Electric (Kansas City, Mo. 64127)
Contract:	FA64WA-5250 (June 30, 1964)

FROM FAA LIBRARY INSTRUCTION BOOK TI 6610.1 (7 July 1972):

Section 1.:	General Description
Section 6.:	Preventive Maintenance
Section 7.:	Corrective Maintenance
Section 11.:	Photographs
Fig. 11-6 Fig. 12-2	Modulator TV-35/A1 w/17-pin Elco connector 7022 (Varicon), 0.100-inch centers, two-part connector (Scale- 4:5) Size: width= 3.0-inches, length= 5.0-inches
Figs. 11-5/12-3	Power Supply Regulator
Figs. 11-11/12-6	Oscillator
Figs. 11-10/12-5	RF Preamp
Figs. 11-13/12-4	Protection Circuit

FROM OKLAHOMA CITY (28 July 1972):

TV-35/A1	Single-sided, 16 contacts used, approximately 70% component density (4-transistors, 11-capacitors, 19-resistors, and 4-diodes).
TV-35/A6	7 contacts used, approximately 50% component density (7-resistors, 3-transistors, 5-diodes).

Equipment:	Weather & Fixed Map Unit
Nomenclature:	WFMU

FROM OKLAHOMA CITY (24 July 1972):

Board Size:	2.5-inches long by 4.0-inches wide and 2.5-inches long by 8.8-inches long
Board Type:	Double-sided printed wiring
Connector:	Card-edge (one-part) - 0.125-inch centers 60 contacts and 136 contacts depending on board width.
Photographs:	Photographs were taken of 16 different printed wiring board designs.

Equipment:	Common Digitizer
Nomenclature:	AN/FYQ-47/49

FROM OKLAHOMA CITY (24 July 1972):

Board Size:	5.9-inches wide by 5.6-inches long
Board Type:	Double-sided printed wiring
Connector:	Card-edge (one-part) with 50 contacts on 0.200-inch centers.
Photographs:	Photographs were taken of 56 different printed wiring board designs, including 6 from the Data Receiver Group.

APPENDIX B

COMPUTER ANALYSIS

PRINTED CIRCUIT BOARD EVALUATION

SEQ NO.	EQPMT TITLE	ASS'Y NO.	BOARD LGTH	BOARD WDTH	# L	INOUT C	#TU	CP-1 ST#U	CP-2 ST#U	CP-3 ST#U	CP-4 ST#U	CP-5 ST#U	CP-6 ST#U	CP-7 ST#U	A D	R #	B #	G #
001	REDE-5	PB 1	6.0	5.0	1	A	9	AB38	BB 7	BC 7	DB 3	EC 8			1	4	1	2
002	REDE-5	PB 2	6.0	5.0	2	A	11	AB53	BB10	BC10	DB 2	JN 1			6	5	0	2
003	REDE-5	PB 3	6.0	5.0	2	A	16	AB41	BB40	BC 6					2	5	0	2
004	REDE-5	PB 4	6.0	5.0	1	A	14	AB27	BB15	BC 3	OA 4				2	5	0	2
005	REDE-5	PB 5	6.0	5.0	1	A	12	AB16	BB 2	BC 2	OA 6				1	5	1	2
006	REDE-5	PB 6	6.0	5.0	2	A	19	AB26	BB17	BC 6	OA 7				2	5	0	2
007	REDE-5	PB 7	6.0	5.0	1	A	16	AB17	BB12	BC 4	OA 5				2	5	1	2
008	REDE-5	PB 8	6.0	5.0	1	A	11	AB 7	BB27	JN 1	OA 3	UH 2			1	0	0	2
009	REDE-5	PB 9	6.0	5.0	1	A	14	AB 2	BB43	CB 5	BC12	HB 4	OA 3		1	5	0	2
010	REDE-5	PB 10	6.0	5.0	2	A	20	AB99	BB40	BC 2	OA 6	AC 8			1	5	1	2
011	REDE-5	PB 11	6.0	5.0	1	A	5	AB 2	BB 5	CB 2	HB 1	OA 3			1	5	0	2
012	REDE-5	PB 12	6.0	5.0	1	A	6	AB 2	BB26	DB 3	BC 5	EC 2			1	5	8	2
013	REDE-5	PB 13	6.0	5.0	1	A	7	AB47	BB 4	BC 9	DB 3	HB 1	CC 1		1	5	0	2
014	REDE-5	PB 14	6.0	5.0	2	A	13	AB32	BB36	DB 7	HB 4	GD 2	BC 7	AC 2	2	5	0	2
015	REDE-5	PB 15	6.0	5.0	2	A	20	AB86	BB11	CB11	BC 5	OA 5	AC13		1	5	0	2
016	REDE-5	PB 16	6.0	5.0	2	A	29	AB99	BB12	CB31	AC10	AB14			1	5	2	2
017	REDE-5	PB 17	6.0	5.0	2	A	5	AB20	BB26	DB 9	BC11	OA 7	EC 1		2	4	0	2
018	REDE-5	PB 18	6.0	5.0	1	A	17	AB34	BB22	CB 4	BC 3	DB 1	OA 4	AC 5	2	5	0	2
019	REDE-5	PB 19	6.0	5.0	1	A	25	AB39	BB17	BC 2	OA 5				1	0	0	2
020	REDE-5	PB 20	6.0	5.0	1	A	29	AB82	BB25	AC16	OA 9				1	0	0	2
021	REDE-5	PB 21	6.0	5.0	1	A	26	AB18	BB 3	OA 7					1	0	1	2
022	REDE-5	PB 22	6.0	5.0	1	A	27	AB13	BB 3	OA 7					1	0	1	2
023	REDE-5	PB 23	6.0	5.0	2	A	29	AB24	BB41	AC 8	OA 6				2	5	0	2
024	REDE-5	PB 24	6.0	5.0	2	A	29	AB54	BB16	CB 4	EC 1	BC 8	AC 2		2	5	0	2
025	REDE-5	PB 25	6.0	5.0	2	A	25	AB22	BB21	CB 6	BC13	EC 2	TH 1	OA 6	2	5	0	2
026	REDE-5	PB 26	6.0	5.0	2	A	20	AB22	BB22	DB 4	BC 4	OA 7	AC 3		2	5	0	2
027	REDE-5	PB 27	6.0	5.0	2	A	24	AB 7	BB39	CB 1	BC10	OA 6	DB 1	AC 2	6	5	0	2
028	REDE-5	PB 28	6.0	5.0	2	A	29	AB48	BB15	OA 6					1	0	0	2
029	REDE-5	PB 29	6.0	5.0	1	A	23	AB 5	BB48	CB 3	BC 9	JB 1	AC 3		2	5	0	2
030	REDE-5	PB 30	6.0	5.0	2	A	25	AB82	BB22	AC12	OA 4				3	5	1	2
031	REDE-5	PB 31	6.0	5.0	1	A	27	BB27	BC 8	OA 8	AC 2				1	5	0	2
032	REDE-5	PB 32	6.0	5.0	2	A	29	AB 2	BB55	BC22	OA 4				5	5	0	2
033	REDE-5	PB 33	6.0	5.0	2	A	21	AB19	BB36	BC 2	OA 4	AC10			4	5	0	2
034	REDE-5	PB 34	6.0	5.0	1	A	24	AB43	BB16	BC 1	OA 6				1	0	0	2
035	REDE-5	PB 35	6.0	5.0	1	A	29	AB43	BB12	CB 1	OA 3	AC 8			2	5	0	2
036	REDE-5	PB 36	6.0	5.0	2	A	29	AB32	BB31	DB 1	BC 4	OA 6	AC 2		2	5	0	2
037	REDE-5	PB 40	6.0	5.0	2	A	29	AB19	BB47	AC 8	OA 5	CB 1			2	5	0	2
038	REDE-5	PB 41	6.0	5.0	1	A	24	AB 6	BB21	CB 1	OA 7	BC 3	AC 9		2	5	0	2
039	REDE-5	PB 42	6.0	5.0	1	A	18	AB20	BB20	CB 1	BC 3	OA 6			2	0	0	2
040	REDE-5	PB 44	6.0	5.0	2	A	24	AB24	BB72	BC12	OA 5	CB 1			3	5	0	2

PRINTED CIRCUIT BOARD EVALUATION

SEQ NO.	EQPMT TITLE	ASS'Y NO.	BOARD LG	BOARD WD	BOARD TH	# L	INOUT C	INOUT #TU	CP-1 ST#U	CP-2 ST#U	CP-3 ST#U	CP-4 ST#U	CP-5 ST#U	CP-6 ST#U	CP-7 ST#U	A D	R #	B #	G #
041	REDE-5	PB 45	6.0	5.0	2	A	16	AB40	BB40	BC 6	OA 9					2	5	0	2
042	REDE-5	PB 46	6.0	5.0	1	A	21	AB27	BB39	AC 8	OA 4					2	5	0	2
043	REDE-5	PB 48	6.0	5.0	2	A	29	AB24	BB41	AC 8	CB 1	OA 6				2	5	0	2
044	REDE-5	PB 49	6.0	5.0	2	A	29	AB25	BB40	AC 8	CB 1	OA 6				2	5	1	2
045	REDE-5	PB 50	6.0	5.0	1	A	27	AB17	BB 4	OA 7						1	0	1	2
046	REDE-5	PB 51	6.0	5.0	1	A	27	AB15	BB 4	OA 7						1	0	1	2
047	REDE-5	PB 60	6.0	5.0	1	A	6	CB 3	LB 2	UB 2						1	0	0	2
048	REDE-5	PB 61	6.0	5.0	2	A	26	JG 1	AB35	BB33	OA 8	BC 9	CB 1	EB 1		2	5	0	2
049	REDE-5	PB 62	6.0	5.0	1	A	16	DC10	CB 5							1	0	0	2
050	REDE-5	PB 63	6.0	5.0	2	A	9	DC 2	BC 7	AB 4	BB20	DB 5	HB 1			1	5	0	2
051	REDE-5	PB 64	6.0	5.0	2	A	16	AB 8	BB24	CB 1	DB 5	AC 5	BC 4	OA 6		4	5	0	2
052	REDE-5	PB 65	6.0	5.0	1	A	16	BB24	BC10	CB13	DB 3	GB 1				1	5	0	2
053	REDE-5	PB 66	6.0	5.0	1	A	13	AB 8	AC 8	BB34	DB11	ND 1	HH 1	JC 1		1	5	0	2
054	REDE-5	PB 67	6.0	5.0	2	A	11	AB 8	AC 9	OA 3	BB45	DB 5	EB 2	EC 2		2	5	0	2
055	REDE-5	PB 68	6.0	5.0	1	A	14	AB 9	BB11	AC 2	BC 3	DC 2	DB 2	HD 4		3	5	0	2
056	REDE-5	PB 69	6.0	5.0	1	A	8	JF 1	OA 4	BB23	AB 4	FB 1	LB 1	AC 4		1	5	0	2
057	REDE-5	PB 70	6.0	5.0	1	A	9	DC 2	DB 2	BC 6	AB14	BB42	OA 5	DB 2		1	5	0	2
058	REDE-5	PB 71	6.0	5.0	1	A	16	OA 5	DC 2	DB 4	BC 6	AB 2	BB27	NC 1		1	5	0	2
059	REDE-5	PB 72	6.0	5.0	1	A	18	OA 5	BC 9	DC 2	AB11	BB50	FB 1			1	5	0	2
060	REDE-5	PB 73	6.0	5.0	1	A	12	AB 5	BB18	CB 5	DB 4	BC 6	OA 3			1	5	0	2
061	REDE-5	PB 74	6.0	5.0	1	A	10	AB 2	OA 4	BB21	DB 3	HB 1	BC 6			1	5	0	2
062	REDE-5	PB 75	6.0	5.0	1	A	25	HD 5	DC 2	AB 8	OA 3	BB 4	NC 2			2	0	0	2
063	REDE-5	PB 76	6.0	5.0	2	A	13	HD 1	BC10	AB16	BB29	CB 5	NB 4	CC 3		3	5	0	2
064	REDE-5	PB 77	6.0	5.0	1	A	14	NC 2	AB 4	BC 6	BB33	DB 6	CB 2	HB 1		1	5	0	2
065	REDE-5	PB 78	6.0	5.0	1	A	5	ZC 1	AB 1	CB 1	DB 1	HB 1	OA 2			1	0	9	2
066	REDE-5	PB 79	6.0	5.0	2	A	11	AB12	AC12	BB54	CB 4	DB 2	EC 2	OA 7		4	5	0	2
067	REDE-5	PB 80	6.0	5.0	1	A	22	AB 7	BB29	CB 2	DB 4	BC 8	KB 1	OA 6		1	5	0	2
068	REDE-5	PB 81	6.0	5.0	2	A	7	BC 4	OA 3	BC 7	AB17	DB 4	AB46			2	5	0	2
069	REDE-5	PB 82	6.0	5.0	1	A	14	DB 5	OA 4	BC 6	DC 2	AB 7	BB40	NC 1		2	5	0	2
070	REDE-5	PB 83	6.0	5.0	1	A	9	ZC 1	AB 1	BB 1	DB 4	OA 2				1	0	9	2
071	REDE-5	PB 84	6.0	5.0	2	A	27	DC 8	AC 8	AB45	BB50	CB 1				1	5	0	2
072	REDE-5	PB 85	6.0	5.0	2	A	25	HD 1	BC 9	EB 1	CB 6	AB20	BB49	OA 2		4	5	1	2
073	REDE-5	PB 86	6.0	5.0	1	A	20	HD 2	AB59	DC 5	BC 5	JB 1	BB 6	CB 3		0	5	0	2
074	REDE-5	PB 87	6.0	5.0	1	A	17	HD 6	DC 6	BC 2	OA25	AB 4	BB17	CB 7		2	0	0	2
075	REDE-5	PB 88	6.0	5.0	1	A	19	OA 5	AB13	BB33	BC 8	DB 4	AC 1			2	5	0	2
076	REDE-5	PB 89	6.0	5.0	1	A	19	AB 5	BB39	DB10	BC 5	DC 2	NC 4	OA 5		1	5	0	2
077	REDE-5	PB 90	6.0	5.0	1	A	19	DC 2	BC12	CD 4	CB 2	BB47	OA 3			1	5	0	2
078	REDE-5	PB 91	6.0	5.0	1	A	13	HD 5	JB 2	DC 5	BB 5	DB 2	EB 1	OA21		2	0	0	2
079	REDE-5	PB 92	6.0	5.0	1	A	11	AB 2	OA 6	BB34	DB 4	BC 6				1	5	0	2
080	REDE-5	PB 93	6.0	5.0	1	A	9	HD 1	OA 4	BC 7	AB10	BB21	DB 3	FB 2		4	5	0	2

PRINTED CIRCUIT BOARD EVALUATION

SEQ NO.	EQPMT TITLE	ASS'Y NO.	BOARD LG	BOARD H"	BOARD WD	BOARD H	# L	INOUT C	INOUT #	CP-1 ST#U	CP-2 ST#U	CP-3 ST#U	CP-4 ST#U	CP-5 ST#U	CP-6 ST#U	CP-7 ST#U	A D	R #	B #	G #
081	REDE-5	PB 94	6.0		5.0	2	A		11	OA 5	BB33	CB 4	DB 7	BC 4			1	5	4	2
082	REDE-5	PB 95	6.0		5.0	1	A		21	HD 5	BB 4	BC 1	OA10				1	0	0	2
083	REDE-5	PB 96	6.0		5.0	1	A		21	HD 5	DC 5	BB 8	DB 4	OA28			2	0	0	2
084	REDE-5	PB110	6.0		5.0	1	A		9	OA10	ZK 1	DB 4	EB 2	BB 3			1	0	0	2
085	REDE-5	PB111	6.0		5.0	2	A		15	AB35	OA 9	BB11	DB 7	BC 9	DC 2	NB 3	1	5	0	2
086	REDE-5	PB112	6.0		5.0	1	A		9	OA 5	AB25	BB 5	CB 5	DB 5	BC 7	DC 2	1	5	0	2
087	REDE-5	PB114	6.0		5.0	2	A		23	NC 2	AC 5	BC 4	AB36	BB 4	DB14	OA 2	2	5	0	2
088	REDE-5	PB115	6.0		5.0	2	A		17	AB45	BC10	DB26	EB 1	OA 3	BB 2		4	5	0	2
089	REDE-5	PB117	6.0		5.0	2	A		11	AB38	BB10	CB 5	DB 8	BC 6	DC 1	OA 7	1	5	0	2
090	REDE-5	PB118	6.0		5.0	1	A		10	OA 8	BC10	DC 3	AB23	DB 3	EB 4		1	5	0	2
091	REDE-5	PB119	6.0		5.0	1	A		10	AB11	BB 1	CB 4	EB 3	DC 3	BC 5	OA 7	1	5	0	2
092	REDE-5	PB120	6.0		5.0	1	A		7	OA 8	AB 6	BB15	DB 4	BC 4	DC 2	EB 1	2	5	0	2
093	REDE-5	PB121	4.2		5.0	1	A		21	BB16	DB 9	DC 3	EB 2	JB 3	LB 1		1	0	0	2
094	REDE-5	PB131	6.0		5.0	1	A		12	NC 1	OA 4	AB 2	BB12	DB 8	BC 2	RC 1	1	0	0	2
095	REDE-5	PB133	6.0		5.0	1	A		8	NB 2	AB23	BB 4	BC 7	DC 2	DB 4	OA 5	1	5	0	2
096	REDE-5	PB134	6.0		5.0	1	A		11	AB 8	OA 2	BB16	CB 3	DB10	JB 1	BC 5	1	5	0	2
097	REDE-5	PB138	6.0		5.0	1	A		15	BC11	DC 8	AB11	BB33	DB 3	EB 6	OA 8	1	5	0	2
098	REDE-5	PB151	6.0		5.0	1	A		17	DC 2	BC 8	AB18	BB33	DB 2	EB 2	OA 9	1	5	0	2
099	REDE-5	PB152	6.0		5.0	1	A		19	OA 8	BC 9	AB13	BB41	DB 3	EB 1	HB 1	1	5	0	2

PRINTED CIRCUIT BOARD EVALUATION

SEQ NO.	EQPMT TITLE	ASS'Y NO.	BOARD LGTH	BOARD WDTH	# L	INOUT C	#TU	CP-1 ST#U	CP-2 ST#U	CP-3 ST#U	CP-4 ST#U	CP-5 ST#U	CP-6 ST#U	CP-7 ST#U	A D	R #	B #	G #
100	RTC-3	1903637	3.3	4.3	1	B	8	BB15	CB 1	DB 4	BE 6	DE 1	FB 1		1	5	0	2
101	RTC-3	1903638	3.3	4.3	1	B	8	BB15	CB 1	DB 4	BE 6	DE 1	FB 1		1	5	0	2
102	RTC-3	1903639	3.3	4.3	1	B	14	BB10	AB 7	CB 5	EB 3	DE 1	FB 1	KB 2	1	5	0	2
103	RTC-3	328752	6.0	5.2	1	C	8	AB 8	OA 4	BB20	CB 7	DB 6	EB 4	BC 8	1	5	0	2
104	RTC-3	328865	6.0	5.2	2	D	10	CM 8	OA 5	AB 1	BB10	AC 1	CB 1	DC 1	2	5	3	2
105	RTC-3	329106	6.0	5.2	1	C	11	AB 9	BB33	CB10	BC 8	AC 4	OA 6	FB 1	1	5	0	2
106	RTC-3	329107	6.0	5.2	2	D	15	CM 4	AB 9	BB25	CB13	AC 7	BC 3	OA 5	4	5	0	2
107	RTC-3	329244	6.0	5.2	1	C	13	AB 7	BB31	CB11	EB 2	BC10	AC 1	OA 4	1	5	0	2
108	RTC-3	331376	6.0	5.2	2	D	39	CM19	OA 4	BB 2					9	5	4	2
109	RTC-3	331449	6.0	5.2	2	D	23	CM 4	DC 6	DB 9	EB 5	AB10	BB36	BC 9	4	5	0	2
110	RTC-3	331482	6.0	5.2	2	C	12	CM20	BB 2	OA 8					9	5	3	2
111	RTC-3	331662	6.0	5.2	2	D	12	CM 9	BB11	CB 4	BC 1	GB 1	OA 2		8	5	3	2
112	RTC-3	331663	6.0	5.2	2	D	10	CM11	LB 2	AA 4	AB 8	BB15	CB 5	FB 1	4	5	2	2
113	RTC-3	331664	6.0	5.2	2	D	9	CM 2	DC 2	OA 2	DH 1	BB23	CB13	AC 6	2	5	1	2
114	RTC-3	331702	6.0	5.2	2	D	34	CM 9	LB 1	AA 3	BC 5	AB11	BB11	DB 7	6	5	2	2
115	RTC-3	331703	6.0	5.2	2	D	21	CM 5	AB10	BB28	CB11	EB 3	BC 7	AC 4	6	5	1	2
116	RTC-3	331770	6.0	5.2	2	D	14	AB 8	BB22	CB 3	AC 4	BC 7	DC 2	LB 5	1	5	0	2
117	RTC-3	331785	6.0	5.2	2	D	28	BB11	BC 6	EB 6	KH 6	OA 1			2	5	0	2
118	RTC-3	332013	6.0	5.2	2	D	16	CM13	OA 8	AB 5	BB 6	CB 4	EB1		8	5	2	2
119	RTC-3	332014	6.0	5.2	2	D	20	CM17	OA 3	BB12					9	5	3	2
120	RTC-3	332049	6.0	5.2	2	D	17	AB33	BB36	CB 5	DB 4	BC 4	AC 6	OA 5	1	5	1	2
121	RTC-3	332125	6.0	5.2	2	D	15	CM10	CC 6	AB11	BB16	CB 9	DB 5	AC 4	6	5	1	2
122	RTC-3	332170	6.0	5.2	2	D	13	AB16	BB42	CB 3	EB 5	BC10	OA 6		1	5	1	2
123	RTC-3	332194	6.0	5.2	2	D	20	KH 2	CM 5	AB 7	BB20	DB 4	EB 2	OA 4	5	5	2	2
124	RTC-3	332207	6.0	5.2	1	C	8	OA 7	AB 4	BB40	CB 7	CC 4	AC 6	NC 1	1	5	1	2
125	RTC-3	332268	6.0	5.2	2	D	15	DC 4	AC 5	BC 6	BB39	CB11	OA 5	MB 1	1	5	1	2
126	RTC-3	332288	6.0	5.2	2	D	14	BC11	DC 2	AB23	BB35	CB10	DB 4	OA 2	1	5	1	2
127	RTC-3	332293	6.0	5.2	2	D	28	CM 6	AB 5	BB22	CB 3	DB 2	AC 5	OA 3	5	5	3	2
128	RTC-3	343096	10.5	7.0	2	D	26	BC 5	JC 4	AB11	BB31	DC 2	LB 4	DB12	1	5	0	2
129	RTC-3	343317	6.0	5.2	2	D	6	AB 7	BB23	CB26	DB 6	DC 2	BC 7	OA 3	1	5	0	2
130	RTC-3	349051	6.0	5.2	2	D	11	BB53	CB 5	CM 1	DB 1	BC12	AC 5	OA 1	2	5	1	2
131	RTC-3	388185	6.0	5.2	1	C	6	DC 5	AB 9	BB60	CB 4	DB 6	BC14	OA 7	1	5	0	2
132	RTC-3	496375	6.0	5.2	2	D	33	CM16	AB18	BB 8	CB 4	AC 1	OA 4		9	5	2	2

PRINTED CIRCUIT BOARD EVALUATION

SEQ NO.	EQPMT TITLE	ASS'Y NO.	BOARD LGTH	BOARD WDTH	# L	INOUT C	#TU	CP-1 ST#U	CP-2 ST#U	CP-3 ST#U	CP-4 ST#U	CP-5 ST#U	CP-6 ST#U	CP-7 ST#U	A D	R #	B #	G #
133	ATCBI-4	707075	2.5	4.0	2	E	26	CM 3	OA 6	BC 2	AC 4	AB39	BB 1	CB 1	2	5	0	1
134	ATCBI-4	707077	2.5	4.0	2	E	6	OB51	RB 8	BC15					1	0	0	1
135	ATCBI-4	707079	2.5	4.0	2	E	37	DC 2	CM 2	BC 2	AC 8	AB22	BB 8	OA 5	1	5	0	1
136	ATCBI-4	707082	2.5	4.0	2	E	7	AB22	CB 6	BB 2	AC 5				2	5	0	1
137	ATCBI-4	707096	2.5	4.0	2	E	25	CM 1	BC 3	OA10	AB35	EC 1			3	5	0	1
138	ATCBI-4	707098	2.5	4.0	2	E	44	CM 4	OA 8	AB 2	BB 6	CB 1	BC 1		8	5	0	1
139	ATCBI-4	707235	2.5	4.0	2	E	60	CM 4	AB 1	BB 1	OA58				5	5	0	1
140	ATCBI-4	707237	2.5	4.0	2	E	60	CM 5	AB 1	BB 1					9	5	0	1
141	ATCBI-4	707239	2.5	4.0	2	E	60	CM 5	BB 2						9	5	0	1
142	ATCBI-4	707241	2.5	4.0	2	E	60	CM 5	BB 5						2	5	0	1
143	ATCBI-4	707243	2.5	4.0	2	E	60	CM 5	BB 2						5	5	0	1
144	ATCBI-4	707245	2.5	4.0	2	E	28	CM 1	BC 4	AC 4	RB49	BB 4			2	5	0	1
145	ATCBI-4	707247	2.5	4.0	2	E	27	GB 3	DB 4	CB 2	BB 4	DC 3			1	5	0	1
146	ATCBI-4	707249	2.5	4.0	2	E	36	CM 3	AB 6	BB11	AC 2	DC 1			4	5	0	1
147	ATCBI-4	707253	2.5	4.0	2	E	45	CM 1	EJ 4	AC 4	OA 4	AB21	BB 2		2	5	0	1
148	ATCBI-4	707255	2.5	4.0	2	E	46	CM 2	BB12	AB 8	OA 6				6	5	0	1
149	ATCBI-4	707314	2.5	4.0	2	E	20	AB23	BB 8	CB 9	BC 1	AC 3			1	5	0	1

PRINTED CIRCUIT BOARD EVALUATION

SEQ NO.	EQPMT TITLE	ASS'Y NO.	BOARD LGTH	BOARD WDTH	# L	INOUT C	#TU	CP-1 ST#U	CP-2 ST#U	CP-3 ST#U	CP-4 ST#U	CP-5 ST#U	CP-6 ST#U	CP-7 ST#U	A D	R #	B #	G #
150	FA-7280	P4109	11.8	8.3	1	F	14	AB98	BC32	DC19	BB33	DB 8	MF 4	EC 6	1	5	0	2
151	FA-7280	P4110	11.8	8.3	1	F	22	AB99	BB75	DC 8	BC35	GF 2	RH 2	WH 1	1	5	0	2
152	FA-7280	P4111	11.8	8.3	1	F	12	AB99	BB64	BC44	DC 8				1	5	0	2

PRINTED CIRCUIT BOARD EVALUATION

SEQ NO.	EQPMT TITLE	ASS'Y NO.	BOARD LGTH"	BOARD WDTH	# L	INOUT C	#T	CP-1 ST#	CP-2 ST#	CP-3 ST#	CP-4 ST#	CP-5 ST#	CP-6 ST#	CP-7 ST#	A D	R #	B #	G #
153	RVR	M01 UFF	5.3	4.5	1	G	35	AB24	BB 8	BC 8	BA 4	CB 4	RB48		1	0	0	2
154	RVR	M02.UFF	5.3	4.5	1	G	35	AB24	BB 8	CB 4	BA 4	RB48			1	0	0	2
155	RVR	M03 XMT	5.3	4.5	2	G	33	AB89	BB 2	BC 9					1	5	0	2
156	RVR	M04 SBB	5.3	4.5	2	G	27	AB88	BC11	BB11					1	5	0	2
157	RVR	M06 LST	5.3	4.5	1	G	15	AB30	BB 6	BC13					1	5	0	2
158	RVR	M07 CPG	5.3	4.5	2	G	22	AB43	BB 4	BC16					1	5	0	2
159	RVR	M08 22S	5.3	4.5	2	G	34	AB73	BC 6						1	5	0	2
160	RVR	M10 HDC	5.3	4.5	2	G	27	AB80	BC16						1	5	0	2
161	RVR	M11 OCC	5.3	4.5	2	G	30	AB33	BC 8						1	5	0	2
162	RVR	M12 FDC	5.3	4.5	1	G	10	AB27	BB 2	DB 1	EB 1	BC10			1	5	0	2
163	RVR	M13 LSR	5.3	4.5	2	G	20	AB64	BC13	BB 2	CB 2				1	5	0	2
164	RVR	M18 TBL	5.6	15.0	2	H	52	AB99	AB99						1	0	0	2
165	RVR	M19 TBL	5.6	15.0	2	H	52	AB99	AB99	BC 6					1	0	0	2
166	RVR	M20 TBL	5.6	15.0	2	H	52	AB99	AB99						1	0	0	2
167	RVR	M21 STS	5.3	4.5	1	G	13	AB31	BB 5	CB 2	BC12				1	5	0	2
168	RVR	M25 CLC	5.3	4.5	1	G	35	AB42	BB10	BC11	CB 1	BA 8			1	5	0	2
169	RVR	M26 SCC	5.3	4.5	1	G	23	AB58	BC12	BA 6	BB 1				1	5	0	2

PRINTED CIRCUIT BOARD EVALUATION

SEQ NO.	EQPMT TITLE	ASS'Y NO.	BOARD LGTH	BOARD WDTH	# L	C	INOUT D	CP-1 #TU	CP-1 ST#U	CP-2 ST#U	CP-3 ST#U	CP-4 ST#U	CP-5 ST#U	CP-6 ST#U	CP-7 ST#U	A D	R #	B #	G #
170	CODEDTS	ATT1153	4.1	4.5	2	D	27	CM 7	BB 1	DB 2						9	5	1	2
171	CODEDTS	DCL1156	4.1	4.5	2	D	21	CM 7	DB 2	BB 1						9	5	3	2
172	CODEDTS	ATT1162	4.1	4.5	2	D	23	AB10	BB 2	CB 7	DB 1	EB 2	BC 3	GB 1		1	0	0	2
173	CODEDTS	ATT1168	4.1	4.5	2	D	5	AB15	BB24	AC 6	BC 4	DB 9				1	5	0	2
174	CODEDTS	1171	4.1	4.5	2	D	30	CM14	AB 1	DB 2						8	5	1	2
175	CODEDTS	DCL1172	4.1	4.5	2	D	41	CM 4	BB 1	DB 2						9	5	0	2
176	CODEDTS	ATT1180	4.1	4.5	2	D	28	CM 7	BA 8	BB 1	DB 2					9	5	1	2
177	CODEDTS	ATT1186	4.1	4.5	2	D	42	CM10	BA 8	BB 1	DB 2					9	5	0	2
178	CODEDTS	ATT1189	4.1	4.5	2	D	44	CM 4	BB 1	DB 2						9	4	0	2
179	CODEDTS	DCL1192	4.1	4.5	2	D	42	CM 4	BB 1	DB 2						9	4	0	2
180	CODEDTS	ATT1195	4.1	4.5	2	D	39	CM15	CB 1	DB 1	BB 1					8	5	0	2
181	CODEDTS	CLI1198	4.1	4.5	2	D	38	CM12	BB 1	DB 2						9	5	0	2
182	CODEDTS	CLI1201	4.1	4.5	2	D	39	CM10	BB 1	BA 8	DB 2					9	5	0	2
183	CODEDTS	1204	4.1	4.5	2	D	8	AB 9	BB18	BC10	DC 2	DB 2				1	5	0	2
184	CODEDTS	ATT1207	4.1	4.5	2	D	21	BB42	AC18							3	5	0	2
185	CODEDTS	1252	4.1	4.5	2	D	18	AB31	DB 6	FB 2	AC 6	BC 4				1	5	0	2
186	CODEDTS	1255	4.1	4.5	2	D	15	AB45	BC21	AC 3						3	5	0	2
187	CODEDTS	CLI1258	4.1	4.5	2	D	10	CM 1	AB 5	BB22	AC 7	BC 1	DB 3	EB 4		4	5	0	2
188	CODEDTS	1261	4.1	4.5	2	D	13	BB33	BC13	DC 2	DB 7	EB 2				1	5	0	2
189	CODEDTS	1264	4.1	4.5	2	D	7	DC10	AC 2	AB13	BB30	DB 4				1	5	0	2
190	CODEDTS	EDS1265	4.1	4.5	2	D	8	BB31	AB11	AC12	DB 2					1	5	0	2
191	CODEDTS	EDS1269	4.1	4.5	2	D	8	BC10	BB30	DB 6						1	5	0	2
192	CODEDTS	CLI1279	4.1	4.5	2	D	4	BC 8	AB 2	BB20	DB 5					1	5	0	2
193	CODEDTS	DCL1282	4.1	4.5	2	D	9	BC12	BB39	DB 3						2	5	0	2
194	CODEDTS	ATT1293	4.1	4.5	2	D	44	CM 3	BB1	DB 2						9	4	0	2
195	CODEDTS	1324	4.1	4.5	2	D	6	CM 3	BB10	AB 2	AC 3	DB 2	EB 1	NB 1		5	4	0	2
196	CODEDTS	CLI1336	4.1	4.5	2	D	23	AB 3	AC 3	BB13	BC 3	DB 2	KH 3			1	4	0	2
197	CODEDTS	DCL1401	4.1	4.5	2	D	9	AB 4	BB21	AC 8	BC 2	DC 2	DB 8			2	4	0	2
198	CODEDTS	BPS1417	4.1	4.5	2	D	8	CM 1	BC 2	BB 8	CB 1	DB 2				3	4	0	2
199	CODEDTS	PSLVD	4.1	4.5	2	D	17	KH 1	AB 3	BB20	DB 3	DC 1				1	4	0	2
200	CODEDTS	BPFI	4.1	4.5	2	D	11	AC 2	BC 3	AB 3	BB16	DC 1	DB 2			1	5	0	2
201	CODEDTS	DCL2IN	4.1	4.5	2	D	44	CM 4	DB 2	BB 1						9	5	0	2
202	CODEDTS	DCLJKFF	4.1	4.5	2	D	38	CM 3	BA 6	BB 1	DB 2					9	5	0	2
203	CODEDTS	JKFF	4.1	4.5	2	D	28	CM 3	BA 6	BB 1	DB 2					9	5	0	2
204	CODEDTS	ATTIN	4.1	4.5	2	D	44	CM 4	BB 1	DB 2						9	5	0	2
205	CODEDTS	ATT4IN	4.1	4.5	2	D	42	CM 4	BB 1	DB 2						9	5	0	2

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SEQ NO.	EQPMT TITLE	ASS'Y NO.	BOARD LGTH	BOARD WDTH	# L	INOUT C	#TU	CP-1 ST#U	CP-2 ST#U	CP-3 ST#U	CP-4 ST#U	CP-5 ST#U	CP-6 ST#U	CP-7 ST#U	A D	R #	B #	G #
206	MARK-IA	GS 2A1	4.5	5.8	2	A	26	AB15	BB32	DB 5	BC 6	AC 2			1	0	0	2
207	MARK-IA	GS 3A4	5.0	4.0	1	F	17	AB14	BB 5	DB 3	BA 6				1	0	0	2
208	MARK-IA	MRK 2A2	4.4	6.7	2	J	17	AB12	BB42	CB 3	BC 8	DC 1	NB 1	HF 1	1	5	0	2
209	MARK-IA	LOC 3A5	5.0	4.3	2	J	10	AB31	BB 5	BC 9	BA 6	DB 4	LF 1		1	5	0	2
210	MARK-IA	TEL 3A1	5.0	6.0	2	F	21	AB67	BB 2	BA 3	DC 2	BC 7	EB 2	EH 1	1	0	0	2
211	MARK-IA	MRK 2A5	4.4	6.7	1	J	16	AB37	BC 7	DB 5	BA 6	CB 5	DC 1	EH 2	1	0	0	2
212	MARK-IA	LG7A1A1	3.5	4.0	1	J	13	AB 5	BB20	DB 4	BC10				1	5	0	2
213	MARK-IA	L 6A1A1	5.5	7.8	1	J	9	BC14	BA 8	DC 1	AB56	BB22			1	5	0	2
214	MARK-IA	L 6A1A2	5.5	7.8	2	J	13	AB97	BB10	BC 9	BA 9				1	0	0	2
215	MARK-IA	L 6A1A3	5.5	7.8	2	J	6	BA 7	BC 9	AB33	BB 6	TC 1			2	0	0	2
216	MARK-IA	L 6A1A4	5.5	7.8	2	F	21	OA54	BA 8	AB92	BC 6	BB 3			2	0	1	2
217	MARK-IA	L 6A1A5	5.5	7.8	2	J	9	BA 8	AB39	BC 8	BB20	CB 4	DC 2	LF 1	1	5	0	2
218	MARK-IA	S C 1A1	3.3	6.5	2	A	26	AB55	BB 9	BC11					2	5	0	2
219	MARK-IA	LOC 2A1	4.5	5.8	2	A	28	AB 7	BB42	BC 8	DB 3	EB 3			1	0	0	2
220	MARK-IA	STAT2A1	3.3	6.5	2	A	26	AB 4	BB25	CB13	BC12				2	5	0	2
221	MARK-IA	MRK 2A3	4.4	6.7	2	J	7	CM 4	AB 6	BB17	CB 3	DB 2	BC 6	OD 1	2	5	0	2
222	MARK-IA	MRK 3A1	6.5	3.0	1	J	17	AB 3	BB12	CB 5	DC 3	BA 1	BC 5		1	0	0	2
223	MARK-IA	TEL 3A2	4.0	4.8	2	F	23	AB 5	CB 8	EB 4					1	0	0	2
224	MARK-IA	S C 1A2	3.3	6.5	2	A	27	BC11	AB47	BB 6					1	5	0	2
225	MARK-IA	L G 3A1	4.0	4.8	1	F	13	AB22	CB 2	FB 1	BC 5	BA 2	GB 2		1	0	0	2
226	MARK-IA	3A2/3A3	5.0	6.0	2	A	23	BA 8	DC 3	DL 3	BC 9	AB50	BB10	DB 5	1	5	0	2

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SEQ NO.	EQPMT TITLE	ASS'Y NO.	BOARD LGTH	BOARD WDTH	# L	INOUT C	#TU	CP-1 ST#U	CP-2 ST#U	CP-3 ST#U	CP-4 ST#U	CP-5 ST#U	CP-6 ST#U	CP-7 ST#U	A D	R #	B #	G #
227	MX-8757	101496	3.3	7.8	2	D	27	CM 9	AB36	BB 7	CB15	BC10	BA 2	BB 1	6	5	1	1
228	MX-8757	101497	3.3	7.8	2	D	26	CM13	AB35	BB13	BA 2	BC 1			7	5	0	1
229	MX-8757	101498	3.3	7.8	2	D	29	CM13	BA 2	AB28	BB13	BC 2	DB 1		9	5	1	1
230	MX-8757	101499	3.3	7.8	2	D	18	CM12	BA 3	AB17	BB 5	BC 1	AC 3		9	5	0	1
231	MX-8757	101501	3.3	7.8	2	D	21	CJ24	BA 2	AC15	AB28	BB12	CB 2	RA16	4	5	0	1
232	MX-8757	1015	3.3	7.8	2	D	26	CM 6	DC 5	BA 8	AB52	BB15	AC15		6	5	0	1
233	MX-8757	101503	3.3	7.8	2	D	17	DC 2	RA 4	AC39	AB85	BB22	CB 4		2	5	0	1
234	MX-8757	101504	3.3	7.8	2	D	42	CB 7	KL 5	AB 1					1	0	0	1

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235	CDC/CUE	451625	5.0	3.6	2	L	12	CM 3	BC 4	AB 4	BB 1	DB 2	OA 5		9	4	0	2
236	CDC/CUE	463346	5.0	5.0	2	T		AB22	BB12	OA17	BC 2	CL 1	NB 2	QB1	1	5	4	2
237	CDC/CUE	451594	6.0	5.3	2	M	23	CM 7	JJ 1	BC10	AB35	BB 8	DB 4		4	4	2	2
238	CDC/CUE	451998	6.0	6.0	2	K	31	CM 8	AB16	BB 6	CB 3	CL 1			6	4	1	2
239	CDC/CUE	385950	6.0	5.3	2	M	37	CM 7	AB34	BB10	BA 3	CL 2			5	4	0	1
240	CDC/CUE	5041029	5.8	4.8	2	D	11	BB18	AB 4	CB 8	BC 4	MB 1	FC 2		1	4	0	2
241	CDC/CUE	409559	6.0	6.0	2	K	23	OA51	CM16	CL 3	AB27	BB 5	DB 4		8	4	0	1
242	CDC/CUE	409616	6.0	6.0	2	K	48	OA48	CM20	AB13	BB11				7	4	0	2
243	CDC/CUE	409546	6.0	5.3	2	M	24	AB13	BC 9	CB 4	BB 6	DB 4	DC 2		1	5	0	2
244	CDC/CUE	409547	6.0	5.3	2	M	34	CM 8	BC 8	AB30	BB 5	CB 6	DB 5	PE 1	6	4	2	2
245	CDC/CUE	409397	8.0	4.4	2	T		CM 2	AB23	WB 1	BB33	AC11	DB 2	GB 1	2	4	4	2
246	CDC/CUE	405916	6.0	5.3	2	M	17	CM12	AB 9	BB 6	CB 4	DB 2	BC 3	CH 1	8	4	3	2
247	CDC/CUE	409621	6.0	6.0	2	K	67	OA16	CM23	AB36	AC 2	BB 7	CB 2	DB 1	9	4	1	1
248	CDC/CUE	405715	6.0	6.0	2	K	43	CM16	AB 2	BB 1	CB 1				9	5	0	2
249	CDC/CUE	LOG SD	6.0	6.0	2	K	59	CM11	BB 1	AB 1	CB 1				9	4	0	2
250	CDC/CUE	COM DL	6.0	6.0	2	K	52	CM16	AB13	AC 3	CB 2	DC 1			9	4	0	2
251	CDC/CUE	409856	6.0	5.3	2	M	10	CM 7	BC 6	AB25	BB 6	CB 3	DB 1		6	4	0	2
252	CDC/CUE	450269	6.0	5.3	2	M	44	CM12	AB 8	BB 3	CB 2	BC 2			9	5	0	1
253	CDC/CUE	450271	6.6	3.8	2	L	29	CM 5	CB 1						9	4	0	2
254	CDC/CUE	451963	6.6	3.8	2	L	22	CM16	CB 2						9	4	0	2
255	CDC/CUE	XMT DA	6.0	6.0	2	K	28	OA24	CM25	AB24	BB 8	CB 1			6	5	2	2
256	CDC/CUE	452486	6.0	6.0	2	R	21	OA21	AC13	BC 3	CJ 4	AB51	BB22	CB12	1	5	4	2
257	CDC/CUE	451999	6.0	6.0	2	K	46	CM12	AB 2	BB 1	CB 1				9	4	0	2
258	CDC/CUE	405558	6.0	5.3	2	M	28	CM14	AB 6	BA 3	CB16	DB 1	DC 3	CH 3	5	4	1	2
259	CDC/CUE	405915	6.0	5.3	2	M	13	CM 3	AB27	BB16	CB22	NB 1	BC11	CH 2	2	5	0	2
260	CDC/CUE	405662	4.4	2.4	2	T		BB24	OA22						1	0	0	2
261	CDC/CUE	405694	6.0	6.0	2	R	12	OA14	CJ 4	AC12	BC 2	AB21	BB25	CB 3	1	5	4	2
262	CDC/CUE	405462	8.0	8.0	2	K	46	CM12	AB75	BB 6	AC27	CB 9	GB 1		4	5	4	2
263	CDC/CUE	405465	8.0	8.0	2	K	59	CM24	CJ 3	AB27	BB 6	CB 6	DB 3		8	4	0	2
264	CDC/CUE	405550	9.0	8.0	2	K	38	BA28	CM16	AB29	CB22	AC27			6	4	3	2
265	CDC/CUE	405331	3.2	5.0	2	R	8	AB17	CM 1	AB 6	BB 7	CB 2	BC 4		1	4	4	2
266	CDC/CUE	405545	6.8	10.8	2	N	89	CM45	AB 4	BB13					9	5	1	1
267	CDC/CUE	405869	6.0	5.3	2	M	19	CM 1	BC12	AB57	BB 4	CB 3	GF 3		2	5	0	2
268	CDC/CUE	462970	6.8	10.8	2	N	41	CM21	DC 5	BA 5	BB22	AB12	CJ 2	DB 3	8	5	0	1
269	CDC/CUE	385235	6.0	6.0	2	R	22	CM10	AB25	BB 2	CB 2				9	5	4	2
270	CDC/CUE	405557	6.0	5.3	2	M	16	CM14	CB 1	DB 1					9	5	4	2
271	CDC/CUE	462979	6.8	10.8	2	N	45	CM34	BB21	AB12	GB 1				9	5	0	1
272	CDC/CUE	462976	6.8	10.8	2	N	83	CM46	BB18						9	5	0	1
273	CDC/CUE	576839	8.0	8.0	2	K	57	CM14	AB34	CB 1					9	0	4	1
274	CDC/CUE	PVD HV	5.8	4.8	2	D	15	AB 6	BB15	BA 3	BC 4	TC 1	LB 1	MN 1	1	5	1	2
275	CDC/CUE	5041028	5.8	4.8	2	D	18	AB 8	BB15	CB 4	BC 4	JB 1	WH 1	SF 1	1	5	0	2

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276	CDC/CUE	5041027	5.8	4.8	2	D	20	AB10	BB15	CB 2	BA 3	BC 3	JB 1	JB 1	1	5	1	2
277	CDC/CUE	385991	6.0	5.3	2	D	29	BA10	CM12	AB 9	BB 4	CB 2			9	5	0	2
278	CDC/CUE	385239	6.0	6.0	2	R	14	CM 6	AC10	AB28	BB 2	CB 3	LH 2	DC 3	9	5	4	2
279	CDC/CUE	1385028	2.0	3.2	2	T		AC10	OB19	RB12	AB 2				1	5	4	1
280	CDC/CUE	2385028	2.0	3.2	2	T		CM 2	CB 2	AB 7	BB 1				2	5	4	2
281	CDC/CUE	3385028	2.0	3.2	2	T		CM 3	CB 2	AB 7	BB 1				3	5	4	2
282	CDC/CUE	405461	8.0	8.0	2	K	51	CM30	AB22	BB 3	CB 1				9	5	0	1
283	CDC/CUE	405326	9.0	8.0	2	R	38	BA28	CJ 5	AC18	AB44	BB11	CB 3		4	5	3	2
284	CDC/CUE	405130	9.0	8.0	2	R	37	BA28	CM16	CJ 5	AC45	AB67	BB19	CB 4	4	5	3	2
285	CDC/CUE	405329	9.0	8.0	2	R	37	CM16	BA28	AB30	BB25	CB 2			9	5	3	2
286	CDC/CUE	405242	6.8	10.8	2	N	88	CM45	AB47	BB14					9	5	0	1
287	CDC/CUE	463101	6.8	10.8	2	N	67	CM23	JP12	BB15					9	5	0	1
288	CDC/CUE	364614	5.4	10.8	2	N	69	OA60	CM 5	AB60	BB 3				5	5	0	1
289	CDC/CUE	450688	6.0	6.0	2	K	54	AB31	BB12	CB 3	DB14	BC12	AA 2		1	4	1	2
290	CDC/CUE	385828	6.0	6.0	2	M	41	AB26	CB 3	AA16	CM 8				5	5	1	2
291	CDC/CUE	462968	8.0	12.5	2	N	84	AB26	BB37	BH 7	CM 7	CN 4	EB 4	XL 2	4	4	3	1
292	CDC/CUE	482936	6.8	10.8	2	N	82	BB19	CM26	JP 6					9	5	0	1
293	CDC/CUE	462859	6.8	10.8	2	N	40	BB15	CM44						9	5	0	1
294	CDC/CUE	405219	6.8	10.8	2	N	82	CM44	AB 2	BB14					9	5	1	1
295	CDC/CUE	405327	9.0	8.0	2	K	37	AB64	BE14	CB 4	AC18	BH 5			3	5	3	2
296	CDC/CUE	453161	9.0	8.0	2	K	56	AB75	BE16	CM14	CH 8	FB 3			4	5	3	1
297	CDC/CUE	450559	9.0	8.0	2	K	38	AB20	AA 5	BB 4	CB 1	CM22			8	4	4	2
298	CDC/CUE	428011	7.5	8.0	2	K	70	AB91	AC24	CB 1					3	5	4	1
299	CDC/CUE	453180	7.5	8.0	2	K	76	AB72	BB 8	CB 3	CM12	BH 4			6	5	4	1
300	CDC/CUE	EP1208	7.0	11.0	2	N	30	AB43	BB12	CB 6	UL 2	LD 2	BH 4	AA 6	1	0	4	2
301	CDC/CUE	454073	6.0	5.2	2	M	43	AB10	BB 1	CB 2	AA 6	CM14			9	4	1	2
302	CDC/CUE	409868	6.0	6.0	2	K	69	AB 9	BB 8	CB 2	CM14				9	5	0	2
303	CDC/CUE	454070	6.0	5.2	2	M	25	BB 1	CB 2	AA 4	CM12				9	4	1	2
304	CDC/CUE	385993	5.2	6.0	2	M	42	AB41	BB 1	CB 2	CM 3	AA 1			3	5	0	2
305	CDC/CUE	385540	5.2	6.0	2	M	37	AB 6	BB 3	CB 3	CM11	AA 8			9	5	0	2
306	CDC/CUE	405104	6.0	6.0	2	K	52	AB32	CB 1	CM25					7	5	2	2
307	CDC/CUE	385995	5.2	6.0	2	M	37	AB23	BB 1	CB 3	CM 8	AA 6	CC10		6	5	0	2
308	CDC/CUE	454066	5.2	6.0	2	M	18	AB 8	BB 1	CB 4	CM12	AA 7			9	5	2	2
309	CDC/CUE	385956	5.2	6.0	2	M	31	AB47	BB 5	CB 2	CM 2	AA 5			3	5	1	2
310	CDC/CUE	385934	5.2	6.0	2	M	38	BB 1	CB 2	CM13	AA 6				9	5	0	2
311	CDC/CUE	405114	6.0	6.0	2	K	52	AB95	CH 6	AC24	BE12	CB 3			2	5	4	2
312	CDC/CUE	405766	6.0	6.0	2	K	30	AB39	BB 3	CB 3	BH 3	CM 7			4	5	1	2
313	CDC/CUE	385976	6.6	5.2	2	M	17	BB 2	CB 4	AB 5	CM16				9	5	1	2
314	CDC/CUE	385929	5.5	3.8	2	S	21	AB16	BB19	CB 8	BC 4	CJ 2	AA 6		1	4	4	2
315	CDC/CUE	385975	6.0	5.2	2	M	38	AB10	BB 2	CB 4	BC 1	AA 6	CM16		9	5	0	2

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SEQ NO.	EQPMT TITLE	ASS'Y NO.	BOARD LGTH	BOARD WDTH	# L	INOUT C	#TU	CP-1 ST#U	CP-2 ST#U	CP-3 ST#U	CP-4 ST#U	CP-5 ST#U	CP-6 ST#U	CP-7 ST#U	A D	R #	B #	G #
316	CDC/CUE	385931	5.2	3.8	2	S	30	AB40	BB 8	CB 6	EB 1	DC 2	CM 1	BC 2	1	5	4	2
317	CDC/CUE	385986	6.0	5.2	2	M	31	AB37	BB 3	CB 2	AA 4	CJ 2	CM 8		6	5	1	2
318	CDC/CUE	405134	6.0	6.0	2	K	21	AB19	CB 4	BB 3	CM 5	BE 2	AC 4	CJ 1	2	5	4	2
319	CDC/CUE	385967	6.0	5.2	2	M	40	BB 2	CB 4	AB 1	AA 4	CM19			9	5	0	2
320	CDC/CUE	405332	6.0	6.0	2	K	5	AB 7	BC 2	CB 1	BB 1	CM 1			6	5	4	2
321	CDC/CUE	409156	10.5	8.0	2	T		AB61	BB34	DB 4	BC34	AA63			1	5	4	2
322	CDC/CUE	453179	7.5	8.0	2	K	58	AB39	BB10	CB 1	CM29				1	5	2	1
323	CDC/CUE	453161	8.8	8.0	2	K	66	AB99	AB 9	CB 2	BE16	CJ 8	CM24		8	5	4	1
324	CDC/CUE	405805	7.0	11.0	2	N	94	AB 3	BB13	CM51					9	5	0	1
325	CDC/CUE	462835	7.0	11.0	2	N	86	BB18	CM42						9	5	0	1
326	CDC/CUE	405806	7.0	11.0	2	N	74	AB12	BB25	AC 4	ID 1	CM44			9	5	1	1
327	CDC/CUE	385847	5.8	5.2	2	M	28	AB24	BB12	CB 2	AA 2	CM 6	BC11		5	5	0	2
328	CDC/CUE	385928	5.5	3.8	2	S	23	AB12	BB20	CB 1	DB 2	BC 4	CC 2	BD 7	1	5	2	2
329	CDC/CUE	385530	7.0	5.2	2	M	29	AB37	BB11	CB 2	AA 4	BC10	CM10		9	5	1	2
330	CDC/CUE	385895	5.5	3.8	2	S	14	AB23	BB 9	CB 2	DB 2	BC 3	CC 4	AA 4	1	5	0	2
331	CDC/CUE	462969	8.0	11.0	2	N	23	AB18	BB22	CB 8	CC10	CJ 2	XN 1	NE 2	1	0	5	2
332	CDC/CUE	385056	5.0	10.0	2	T		AB75	AC47	CM19					4	5	3	2
333	CDC/CUE	385154	8.0	10.0	2	T		AB41	BB10	CB25	KB 1	BC22	CC 3	AA 5	3	4	5	2
334	CDC/CUE	462977	6.8	11.0	2	N	97	AB 2	BB17	CM47	UF 2				9	5	0	1
335	CDC/CUE	462278	6.8	11.0	2	N	95	AB 5	BB18	CM45	DC 1				9	5	0	1
336	CDC/CUE	405466	7.5	7.8	2	K	54	AB 7	BB 2	CB 2	BC 1	CM17			9	4	0	2
337	CDC/CUE	405777	6.0	5.2	2	M	32	BB 1	DB 1	CM17					9	4	0	2
338	CDC/CUE	385982	6.0	5.2	2	M	37	AA12	BB 1	CB 2	CM 8				9	5	0	2
339	CDC/CUE	385930	5.2	3.8	2	S	20	AB16	BB19	CB 4	KB 1	CC 4	CJ 2	AA 7	1	5	3	2
340	CDC/CUE	385987	6.0	5.2	2	M	35	AB 3	BB 6	DB 1	AA12	CM15			9	5	0	2
341	CDC/CUE	450687	6.0	6.0	2	K	15	AB36	BB21	CB 1	BC14	AA 2			1	5	0	2
342	CDC/CUE	451592	6.0	5.2	2	M	24	AB33	BB 6	CB 4	KE 2	BC 7	CM 8		4	4	3	2
343	CDC/CUE	450288	6.5	3.8	2	L	15	AB19	BB 2	CB 4	BC 3	CM 8			9	4	2	2
344	CDC/CUE	451591	6.0	5.2	2	M	28	AB34	BB 6	FB 1	BC10	CM 6			6	4	1	2
345	CDC/CUE	451593	6.0	5.2	2	M	16	AB31	BB 4	CB 3	GE 2	CM 9	AC 5		7	4	1	2
346	CDC/CUE	450270	6.0	5.2	2	M	29	BB 3	CM16						9	5	0	2
347	CDC/CUE	450284	6.0	5.2	2	M	37	AB29	BB12	CB 4	BC10	CM11			6	5	0	2
348	CDC/CUE	450353	3.0	3.6	2	C	4	AB 6	BB 2	CB 1	DB 1	FB 1	CM 5		5	4	0	2
349	CDC/CUE	450378	6.5	3.8	2	L	26	EB 2	CM13						9	4	3	2
350	CDC/CUE	451208	6.0	5.2	2	M	16	AB11	BB 7	CB 7	BC 3	CM 2			5	4	1	2
351	CDC/CUE	405257	5.5	3.5	2	E	47	AB18	BB18	CB 1	CM 5				6	5	0	2
352	CDC/CUE	409606	5.5	3.5	2	E	28	AB39	BB10	CB 3	DB 1	AC 4	CM 4		5	5	0	2
353	CDC/CUE	405320	5.5	3.5	2	E	24	AB22	BB 8	CB 1	CM 6				6	5	0	2
354	CDC/CUE	405256	5.5	3.5	2	E	39	AB10	BB 1	CB 1	CM 9				9	5	0	2
355	CDC/CUE	405498	5.5	3.5	2	E	12	AB10	BB 4	CB 1	EB 1	BC 6	CH 3	CM 4	6	5	0	2

PRINTED CIRCUIT BOARD EVALUATION

SEQ NO.	EQPMT TITLE	ASS'Y NO.	BOARD LGTH	BOARD WDTH	# L	INOUT C	#T$_U$	CP-1 ST#$_U$	CP-2 ST#$_U$	CP-3 ST#$_U$	CP-4 ST#$_U$	CP-5 ST#$_U$	CP-6 ST#$_U$	CP-7 ST#$_U$	A D	R #	B #	G #
356	CDC/CUE	405319	5.5	3.5	2	E	20	AB19	BB 3	FB 3	CM 3	DH 1			1	5	0	2
357	CDC/CUE	405318	5.5	3.5	2	E	42	AB23	BB19	FB 1	CM 5				6	5	0	2
358	CDC/CUE	450225	5.5	3.5	2	E	45	AB 7	BB 1	FB 1	CM 6				9	5	0	2
359	CDC/CUE	705000	4.0	4.5	2	G	28	AB29	BB15	BC 5	CM 2	AA 4			1	4	0	2
360	CDC/CUE	ROUND	2.0	2.0	2	T		AB 6	BB 3	CB 1	DB 1	CJ 1			1	4	3	2
361	CDC/CUE	CHARGEN	7.4	11.5	2	N		AB21	TJ 9	CM 9	BC 9	RA20	LC 3	PJ 8	3	5	0	1

PRINTED CIRCUIT BOARD EVALUATION

SEQ NO.	EQPMT TITLE	ASS'Y NO.	BOARD LGTH	BOARD WDTH	# L	INOUT C	#T$_U$	CP-1 ST#$_U$	CP-2 ST#$_U$	CP-3 ST#$_U$	CP-4 ST#$_U$	CP-5 ST#$_U$	CP-6 ST#$_U$	CP-7 ST#$_U$	A D	R #	B #	G #
362	VID MAP	3A1/4A1	4.0	6.0	2	G	15	AB51	BB 7	DC 2	AC 8	BC 2	AA 3		1	0	0	2
363	VID MAP	1A10A3	4.0	6.0	2	J	13	AB43	CB 2	AC14	AA 6				1	0	0	2
364	VID MAP	2A1/6AU	4.0	6.0	2	G	11	AB29	BB 6	DC 2	DB 6	AC 3	BC 2	AA 3	1	0	0	2
365	VID MAP	1A$_{10}$A1	4.0	6.0	2	J	8	AB54	BB 9	DB 2	DC 8	AC 4	BC 4	AA11	1	0	1	2
366	VID MAP	1A9A6	7.4	8.0	2	U	33	AB 3	BB 3	CB 3	CM16	AA 2	YP 2		8	5	1	2
367	VID MAP	A4/5/11	7.4	8.0	2	U	27	AB 1	CB 2	CM32	AA 7				9	5	2	2
368	VID MAP	A9	7.4	8.0	2	U	42	AB26	BB 3	CB 3	AC 7	CM 3	CF 5		6	5	1	2
369	VID MAP	A1/A2	7.4	8.0	2	U	7	AB84	BB29	CB 4	DC 4	PD 3	LD 2	BC30	1	0	0	2
370	VID MAP	AP DDA	7.4	8.0	2	U	28	AB 3	CB 2	AA 7	CM32				9	5	2	2
371	VID MAP	A3/A10	7.4	8.0	2	U	13	AB31	BB 3	CB 4	AC10	CM10	AA 7		6	5	1	2
372	VID MAP	1A914	7.4	8.0	2	U	43	AB33	BB 3	CB 3	AC 3	CM 1	CD 1		4	0	0	2
373	VID MAP	1A9A7	7.4	8.0	2	U	17	AB35	BB 3	CB 6	JB 2	AA 7	AC15	CM 8	4	5	1	2
374	VID MAP	1A9A8	7.4	8.0	2	U	14	AB89	BB 3	EB 7	DC 2	AC14	BC 6	AA 7	1	0	1	2
375	VID MAP	A1-A12	8.0	6.8	2	U	29	AB68	BB10	DB 3	DC 1	CM 6	BC16	AA 5	4	5	1	2
376	VID MAP	A13	8.0	6.8	2	U	19	AB31	CB 2	AC 8	AA11				1	0	1	2
377	VID MAP	693411	8.5	4.9	2	A	25	AB75	BB34	CB 3	AA 4	DC 5	AC 3	BC 7	1	5	3	2
378	VID MAP	693414	8.5	4.9	2	A	18	AB61	BB32	HB 2	DC14	BC10	CE 1	EH 2	1	0	1	2
379	VID MAP	693417	8.5	4.9	2	A	8	AB84	BB65	DC 3	AA 4	AC 2	BC 7		1	0	1	2
380	VID MAP	693420	8.5	4.9	2	A	21	AB79	BB26	CB 3	GB 1	JB 2	BC20	LC 2	1	0	2	2
381	VID MAP	693423	8.5	4.9	2	A	10	AB56	BB76	DC 3	BC 9	AA 6			1	0	1	2
382	VID MAP	693426	8.5	4.9	2	A	29	AB99	AB13	BB24	CM 9	DC 3	CF 1	BC19	1	0	2	2
383	VID MAP	712469	8.5	4.9	2	A	25	AB92	BB10	CB 6	DC 3	AC 5	BC 5	AA 7	1	0	3	2

PRINTED CIRCUIT BOARD EVALUATION

SEQ NO.	EQPMT TITLE	ASS'Y NO.	BOARD LGTH"	BOARD WDTH	# L	INOUT C	#TU	CP-1 ST#U	CP-2 ST#U	CP-3 ST#U	CP-4 ST#U	CP-5 ST#U	CP-6 ST#U	CP-7 ST#U	A D	R #	B #	G #
384	DCPPLER	PC1	5.0	5.0	1	B	12	AB22	BB 4	EB 5	JB 1	BC 5	NC 1	DB 1	1	0	0	2
385	DCPPLER	PC2	5.0	5.0	1	B	13	AB32	BB10	HB 5	AC 5	BC 1	AA 4		1	0	0	2
386	DCPPLER	PC3	5.0	5.0	1	B	12	AB34	EB 5	BB 5	AC 6	BC 1	AA 4		1	0	0	2
387	DCPPLER	PC4	5.0	5.0	1	B	12	AB36	BB 8	EB 4	BC 7	AA 4			1	0	0	2
388	DCPPLER	PC5	2.5	5.0	1	B	14	AB 3	AA 3	EB 2	QD 1				1	0	0	2

PRINTED CIRCUIT BOARD EVALUATION

SEQ NO.	EQPMT TITLE	ASS'Y NO.	BOARD LGTH"	BOARD WDTH	# L	INOUT C	#TU	CP-1 ST#U	CP-2 ST#U	CP-3 ST#U	CP-4 ST#U	CP-5 ST#U	CP-6 ST#U	CP-7 ST#U	A D	R #	B #	G #
389	5-CHANN	200008	5.1	4.9	1	W	18	RB67	CB 5	CC 1	AC18				1	0	0	2
390	5-CHANN	200001	5.1	4.9	1	W	17	AB58	DB 7	AC 8	BC 3				1	0	0	2
391	5-CHANN	200006	5.1	4.9	1	W	18	AB39	DB 1	DC 4	AC14				1	0	0	2
392	5-CHANN	200004	5.1	4.9	1	W	18	AB46	BB 9	DB 1	DC 3	AC12	BC 1	AA 1	1	0	0	2
393	5-CHANN	200009	8.0	8.0	2	X	83	AB72	JF14						1	4	0	2
394	5-CHANN	200003	5.1	4.9	2	W	16	AB72	BB 3	DB 5	DC 5	AC15	BC 3		1	0	0	2
395	5-CHANN	200007	5.1	4.9	1	W	8	AB21	BC 2	DC 5	BC 1	AC 6	AA 2		1	0	0	2
396	5-CHANN	200002	5.1	4.9	1	W	17	AB46	BB 2	DB 3	AC 7	BC 4	CC 1		1	0	0	2
397	5-CHANN	200005	5.1	4.9	1	W	10	AB 6	DC 4	DB 2	BB 1	PC 1	KB 2	KD 1	1	0	0	2
398	5-CHANN	524633	2.5	4.5	1	B	8	OB30	AB16	BC 4	EB 1				1	0	0	2
399	5-CHANN	524634	2.5	4.5	1	B	13	OB29	AB13	AC 1	BC 4	EB 1			1	0	0	2

PRINTED CIRCUIT BOARD EVALUATION

SEQ NO.	EQPMT TITLE	ASS'Y NO.	BOARD LGTH	BOARD WDTH	# L	INOUT C	#TU	CP-1 ST#U	CP-2 ST#U	CP-3 ST#U	CP-4 ST#U	CP-5 ST#U	CP-6 ST#U	CP-7 ST#U	A D	R #	B #	G #
400	ASRDS-3	8113183	6.2	4.5	2	D	10	AB29	BB 9	AC10	DC 2	AA 4	CM 1		4	5	1	2
401	ASRDS-3	8113191	6.2	4.5	2	D	7	AB 1	BB 8	CB 2	DC 2	AA 3	BC 2		1	5	1	2
402	ASRDS-3	8113195	6.2	4.5	2	D	13	AB16	BB 6	BC 4	DC 4	AA 6			1	5	1	2
403	ASRDS-3	8113207	6.2	4.5	2	D	32	BB 1	CM10						9	5	1	2
404	ASRDS-3	8113211	6.2	4.5	2	D	8	AB 6	BB 3	CM10	AA 1				9	5	2	2
405	ASRDS-3	8113215	6.2	4.5	2	D	37	AB14	BB 1	CM14	AA 3				9	5	2	2
406	ASRDS-3	8113219	6.2	4.5	2	D	24	AB43	BB 6	GB 1	AC11	BC 4	AA 2	DC12	1	5	1	2
407	ASRDS-3	8113223	6.2	4.5	2	D	30	BB 1	CM16	AA 3					9	5	2	2
408	ASRDS-3	8113227	6.2	4.5	2	D	12	AB35	BB 3	DB 1	CM12	DC 4	AA 5	AC 3	8	5	1	2
409	ASRDS-3	8113243	6.2	4.5	2	D	9	AB62	BB 2	AC 5	BC 6	DC 1	AA 5		1	5	1	2
410	ASRDS-3	8113263	6.2	4.5	2	D	23	AB49	BB 4	DB 2	GB 1	CM 6	DC 4	AC 8	4	5	1	2
411	ASRDS-3	8113267	6.2	4.5	2	D	9	AB60	BB 2	AC14	BC 3	DC 7	AA 5		1	5	1	2
412	ASRDS-3	8113420	6.2	4.5	2	D	14	AB30	BB19	CB 1	DC 4	AC 4	BC 4	DB 2	1	5	0	2
413	ASRDS-3	8113428	6.2	4.5	2	D	7	AB91	BB24	AC 2	BC 2	DC 2	AA 3		1	5	1	2
414	ASRDS-3	8113439	6.2	4.5	2	D	18	AB65	BB 5	AC30	BC 1	DC 3			1	5	0	2
415	ASRDS-3	8114385	6.2	4.5	2	D	7	AB29	BB 4	DB 3	DC 2	AC 5	BC 1	CM 5	8	5	0	2
416	ASRDS-3	8114389	6.2	4.5	2	D	11	AB23	BB 6	EB 4	DC 4	BC 7	AA 4		1	5	1	2
417	ASRDS-3	8114393	6.2	4.5	2	D	11	AB21	BB 2	DB 1	AC 5	BC 5	AA 3		1	5	1	2
418	ASRDS-3	8114401	6.2	4.5	2	D	13	AB46	BB 4	DC 2	AC 3	BC 3	CM 5	AA 5	8	5	1	2
419	ASRDS-3	8114405	6.2	4.5	2	D	6	AB13	BB 1	AC 1	DC 1	CM10	AA 3		9	5	1	2
420	ASRDS-3	IND DOG	6.2	4.5	2	D	17	AB43	BB 8	CB 2	AC14	BC 2	AA 4		1	5	1	2

PRINTED CIRCUIT BOARD EVALUATION

SEQ NO.	EQPMT TITLE	ASS'Y NO.	BOARD LGTH	BOARD WDTH	# L	C	INOUT #TU	CP-1 ST#U	CP-2 ST#U	CP-3 ST#U	CP-4 ST#U	CP-5 ST#U	CP-6 ST#U	CP-7 ST#U	A D	R #	B #	G #
422	BRITE-2	A1	6.1	9.0	2	S	29	AB19	BB51	CB21	DC 3	BC 8	CJ 1	KC 2	1	4	0	2
423	BRITE-2	A2	6.1	9.0	2	S	32	AB22	BB65	DB 9	DC 7	BC17	CJ 1	KC 2	1	4	0	2
424	BRITE-2	A5	6.1	9.0	2	S	26	AB23	BB71	DB 8	KC 5	DC 4	BC13	CJ 3	1	5	1	2
425	BRITE-2	A6	6.1	9.0	2	S	31	AB18	BB54	CB11	DC 4	BC17	KC 3	KB 2	1	4	0	2
426	BRITE-2	306455	10.0	4.0	2	W	16	AB18	BB 9	CB 8	CM11	DB 2	AC 4		8	4	0	2
427	BRITE-2	504856	7.3	4.0	2	W	8	AB19	BB 4	CB 2	DB 8	CM 1	AC 5	EC 1	2	5	0	2
428	BRITE-2	504858	7.3	4.0	2	W	16	AB24	BB14	CB 4	CM 1	BC 5	JC 3		1	5	0	2
429	BRITE-2	504863	7.3	4.0	2	W	14	AB17	BB 3	EB 1	CB 2	AC 3	BC 6	DC 2	1	5	0	2
430	BRITE-2	506451	10.0	4.0	2	W	17	AB61	CB13	BB 3	CM 9	AC 7	BC13	LB 1	6	5	0	2
431	BRITE-2	0928900	6.1	9.0	2	S	33	AB32	BB70	CB17	DC 4	CM13	BC12	GC 2	1	4	2	2
432	BRITE-2	8114137	6.3	4.5	2	D	12	AB29	BB 7	DB 5	DC 5	BC 9	AA 6		1	5	1	2
433	BRITE-2	8114141	6.3	4.5	2	D	12	AB42	BB 5	CB 2	DB 3	DC 4	AC 8	BC 8	1	5	1	2
434	BRITE-2	8114145	6.3	4.5	2	D	24	AB42	BB17	CB 2	HB 2	AC10	BC 2	DC10	1	5	0	2
435	BRITE-2	8114149	6.3	4.5	2	D	20	AB43	BB18	CB 4	FB 1	AC14	BC 3	DC 8	1	5	0	2
436	BRITE-2	8114153	6.3	4.5	2	D	14	AB31	BC 4	CB 1	JB 1	AC 5	CM 4	DC 4	6	5	1	2
437	BRITE-2	8114157	6.3	4.5	2	D	30	AB22	BB24	CB17	DC 2	AC 6	BC11	AA 3	1	5	1	2
438	BRITE-2	8114161	6.3	4.5	2	D	18	AB14	BB43	CB 9	DC 8	AC17	BC 1	AA 2	1	5	0	2
439	BRITE-2	8114165	6.3	4.5	2	D	16	AB51	BB 8	CB16	DC 2	AC13	AA 1		1	5	1	2
440	BRITE-2	8114169	6.3	4.5	2	D	11	AB27	BB 9	CB 2	DC 2	CM11	AA 6		6	5	2	2
441	BRITE-2	8114173	6.3	4.5	2	D	9	AB40	BB24	AC 5	BC 6	DC 1	AA 5		1	5	1	2
442	BRITE-2	8114177	6.3	4.5	2	D	9	AB33	BB29	AC13	BC 3	DC 7	AA 5	CB 2	1	5	1	2
443	BRITE-2	8114181	6.3	4.5	2	D	11	AB29	BB21	AC 5	DC 5	CM 6	AA 3		6	5	0	2
444	BRITE-2	8114185	6.3	4.5	2	D	22	AB 4	BB 7	CB12	MB 2	DC 2	AC 6	CC 6	1	5	1	2
445	BRITE-2	8114189	6.3	4.5	2	D	6	AB18	BB 5	DC 1	CB 2	HB 2	BC 3	KC 3	1	5	0	2
446	BRITE-2	8114193	3.8	4.5	2	D	12	AB 4	BB 8	EB 4	DC 6	BC 2	AA 6		1	5	0	2
447	BRITE-2	8114201	6.3	4.5	2	D	10	AB 6	BB 8	EB 4	DC 4	BC 2	DC 2	AA 5	1	5	0	2
448	BRITE-2	8114205	6.3	4.5	2	D	14	AB 6	BB13	EB 6	DC 6	BC 3	DC 3	AA 7	1	5	1	2
449	BRITE-2	8114209	6.3	4.5	2	D	15	AB21	BB 9	AA11					1	0	0	2
450	BRITE-2	8114213	6.3	4.5	2	D	9	AB15	BB 4	EB 3	BC 1	CM 1	FC 2	DC 2	4	5	0	2
451	BRITE-2	8114217	6.3	4.5	2	D	8	AB13	BB20	CB 5	CM 2	DC 5	AC 5	BC 2	2	5	1	2
452	BRITE-2	8114276	6.3	4.5	2	D	10	AB27	BB 9	CM 6	AC 5	AA 2			7	5	1	2
453	BRITE-2	VIDEO	10.0	4.0	2	W	17	AB80	BB44	EB14	BC 3	AC19	CJ 1	BH 2	1	5	0	2

PRINTED CIRCUIT BOARD EVALUATION

SEQ NO.	EQPMT TITLE	ASS,Y NO.	BOARD LGTH"	BOARD WDTH	# L	# C	INOUT #TU	CP-1 ST#U	CP-2 ST#U	CP-3 ST#U	CP-4 ST#U	CP-5 ST#U	CP-6 ST#U	CP-7 ST#U	A D	R #	B #	G #
457	BLEC	8003017	4.2	4.0	2	Z	12	AB14	BB 3	CB 6	DB 3	AC 5	BC 7	LC 1	1	5	1	2
458	BLEC	8005330	1.7	7.0	2	T		RB24	BB 2	AC24	BM 7	OA20			1	0	0	1
459	BLEC	8115023	6.4	4.6	2	D	10	AB 6	BB 1	CM12	DD 1				9	4	2	2
460	BLEC	8115054	6.6	10.0	2	D	28	AB95	BB16	CB 5	AC11	BC 5	CM19	CN 4	6	4	1	2
461	BLEC	8115089	6.4	6.8	2	O	58	BB 1	CM18						9	4	1	1
462	BLEC	8115097	6.4	6.8	2	O	26	AB 2	BB 1	CM14					9	4	1	1
463	BLEC	8115102	6.4	4.6	2	D	29	BB 1	CM12						9	4	2	2
464	BLEC	8115110	6.4	6.8	2	O	33	AB10	BB 1	CM18	CN 1	HP 1			9	4	1	1
465	BLEC	8115141	14.0	7.8	2	Y	43	AB99	AB12	BB 9	CM33	AC17	CD 3	JM11	9	4	0	1
466	BLEC	8115162	4.2	4.0	1	B	9	AB46	BB 8	BC 4	FB 2	AC 1			1	5	0	2
467	BLEC	8115272	4.2	4.0	2	B	13	AB52	BB 2	FB 4	BC 2	AC 4	DC 3	AA 5	1	5	0	2
468	BLEC	8115301	6.6	10.2	2	O	63	AB35	BB 1	CM17	AC 1	GH 1			9	4	1	2
469	BLEC	8115323	8.0	8.0	2	Y	30	AB78	BB 6	DB 1	AC15	BD 3	CM17		9	4	0	2
470	BLEC	8115366	4.2	4.0	1	P	6	AB35	BB 5	AC 3	CB 1	BC 6	AA 2		1	5	0	2
471	BLEC	DECODER	1.7	8.0	2	T		BB 1	BM16	OA30					1	0	0	1
472	BLEC	PHASECO	1.7	8.0	2	T		OB65	RB11	RB 3	AB 7	BC 2	BM 1	AC15	1	0	0	1

PRINTED CIRCUIT BOARD EVALUATION

SEQ NO.	EQPMT TITLE	ASS'Y NO.	BOARD LG	BOARD TH	BOARD WD	# L	INOUT C	#TU	CP-1 ST#U	CP-2 ST#U	CP-3 ST#U	CP-4 ST#U	CP-5 ST#U	CP-6 ST#U	CP-7 ST#U	A D	R #	B #	G #
476	ARTSIII	A42	6.0	8.0		2	U	37	BC01	CM21	AB23	BB07	CC01	AA14		9	5	4	2
477	ARTSIII	A24	6.0	8.0		2	U	46	AB99	AB28	BB26	AC07	CM02	JF01	BC02	2	5	4	2
478	ARTSIII	A23	6.0	8.0		2	U	26	AB99	AB38	BB13	AC01	BC09	CC02	AA12	2	5	7	2
479	ARTSIII	A21-2	6.0	8.0		2	U	41	AB09	BB02	CM17	AA12				9	5	2	2
480	ARTSIII	A20-2	6.0	8.0		2	U	40	AB09	BB05	CM16	BC01	AA11			9	5	2	2
481	ARTSIII	A20/1-1	6.0	8.0		2	U	43	AB99	AB62	AC01	BC12	CC06	AA07	JF01	1	5	4	2
482	ARTSIII	A19	6.0	8.0		2	U	42	AB07	BB02	CM18	AA13				9	5	1	2
483	ARTSIII	A18	6.0	8.0		2	U	43	AB04	BB02	CM14	AA11				9	5	1	2
484	ARTSIII	A17-2	6.0	8.0		2	U	27	AB99	AB57	AC18	BC12	AB33	CM02	CB01	2	5	4	2
485	ARTSIII	A17-1	6.0	8.0		2	U	47	AB05	BB02	AA09	CM10				9	5	1	2
486	ARTSIII	A16	6.0	8.0		2	U	44	AB15	AA11	BB02	CM25				9	5	1	2
487	ARTSIII	A15	6.0	8.0		2	U	40	AB10	AA15	BB02	CM19				9	5	3	2
488	ARTSIII	A14-2	6.0	8.0		2	U	37	AB10	AA18	BB02	CM18				9	5	1	2
489	ARTSIII	A13-2	6.0	8.0		2	U	44	AB03	BB02	AA16	CM15				9	5	1	2
490	ARTSIII	A13-1	6.0	8.0		2	U	47	AB84	RB12	AA12	BC09	AC04	BC05	CM18	6	5	3	2
491	ARTSIII	A12-3	6.0	8.0		2	U	41	AB19	RB20	CM15					9	5	4	2
492	ARTSIII	A12-2	6.0	8.0		2	U	46	AB03	BB02	CM17	AA20				9	5	1	2
493	ARTSIII	A11-1	6.0	8.0		2	U	45	AB03	BB02	CM16	AA16				9	5	1	2
494	ARTSIII	A14-1	6.0	8.0		2	U	22	AB04	BB03	CM15	AA01				9	5	1	2
495	ARTSIII	A10-2	6.0	8.0		2	U	39	AB52	BB10	CM17	BC01	AA13			9	5	2	2
496	ARTSIII	A8	6.0	8.0		2	U	16	AB41	BB12	BC02	CM11	CC02	AA12		9	5	2	2
497	ARTSIII	A7-2	6.0	8.0		2	U	9	AB07	BB02	CM21	AA11				9	5	1	2
498	ARTSIII	A7-1	6.0	8.0		2	U	43	AB04	BB02	CM25	AA07				9	5	1	2
499	ARTSIII	A6-2	6.0	8.0		2	U	16	AB68	BB06	CM02	CC02	AC13	BC03	AA10	4	5	0	2
500	ARTSIII	A5-3	6.0	8.0		2	U	41	AB90	BB09	CM15	AA16				4	5	3	2
501	ARTSIII	A5-2	6.0	8.0		2	U	45	AB99	BB03	AC16	CM10	AA03			6	5	0	2
502	ARTSIII	A4/A6-1	6.0	8.0		2	U	29	AB10	BB02	CM24	AA14				9	5	1	2
503	ARTSIII	A3	6.0	8.0		2	U	47	AB96	AC16	BB03	CM08	AA03			9	5	1	2
504	ARTSIII	A3	6.0	8.0		2	U	13	AB06	BB04	CC01	CM19	AA11			9	5	1	2
505	ARTSIII	MSN46	6.0	8.0		2	U	29	AB69	BB08	AC10	BC09	AA11	CM14		4	5	3	2
506	ARTSIII	MSN58	6.0	8.0		2	U	30	AB70	BB07	CM14	RB39	AC02	BC15	KF02	4	5	3	2
507	ARTSIII	MSN204	6.0	8.0		2	U	38	AB84	BB06	AC20	BC09	AA11	CM08		4	5	4	2
508	ARTSIII	6866521	6.0	8.0		2	U	46	AB27	RB99	RB26	CM08	AC20	BC33	KJ03	2	5	4	2
509	ARTSIII	6866852	6.0	8.0		2	U	45	AB25	BB04	AA04	CM28				9	5	1	2
510	ARTSIII	6867061	6.0	8.0		2	U	38	AB41	BB06	AA11	BC02	CM25			9	5	2	2
511	ARTSIII	A2	6.0	8.0		3	U	39	AB69	BB18	DB02	CC06	AC11	CM07	KC01	6	5	3	2
512	ARTSIII	750020	3.0	3.2		2	I	56	OB22	AB02	BM08	RB03				1	0	1	1
513	ARTSIII	750140	3.0	3.2		2	I	56	AB07	BB01	BM09	RB03				1	0	3	1
514	ARTSIII	750120	3.0	3.2		2	I	56	OB12	AB01	BM10	RB03				1	0	1	1
515	ARTSIII	7500110	3.0	3.2		2	I	56	BB01	BM06	RB03					8	5	4	1

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SEQ NO.	EQPMT TITLE	ASS'Y NO.	BOARD LGTH	BOARD WDTH	# L	INOUT C	#TU	CP-1 ST#U	CP-2 ST#U	CP-3 ST#U	CP-4 ST#U	CP-5 ST#U	CP-6 ST#U	CP-7 ST#U	A D	R #	B #	G #
526	ARTSIII	750150	3.0	3.2	2	I	56	AB16	BB01	BM08	RB03				1	0	4	1
527	ARTSIII	750050	5.0	3.0	2	I	42	RB03	BB01	BM06					1	0	4	1
528	ARTSIII	750170	3.0	3.2	2	I	56	RB03	BB01	BM08					1	0	4	1
529	ARTSIII	750350	3.0	3.2	2	I	56	AB16	BB01	RB03	BM08				1	0	1	1
531	ARTSIII	750990	3.0	3.2	2	I	18	AB05	BB14	RB03	BC02	CC01	DC01	CB01	1	0	4	1
533	ARTSIII	751245	3.0	3.2	3	I	31	RB20	BB02	BM08	DP02	RB03			6	0	4	1
534	ARTSIII	751230	3.0	3.2	3	I	56	RB55	BB01	BM02	RB03	CC04			2	0	0	1
535	ARTSIII	750030	3.0	3.2	2	I	36	BB01	BM05	RB03					9	0	3	1
536	ARTSIII	750080	3.0	3.2	3	I	56	AB22	BB01	BM11	RB03				7	0	1	1
537	ARTSIII	751295	3.0	3.2	3	I	56	AB03	BB01	BM11	RB03				8	0	5	1
538	ARTSIII	751275	3.0	3.2	2	I	56	RB48	BB01	RB03					1	5	4	1
539	ARTSIII	751325	3.0	3.2	3	I	26	RB14	BB10	RB03	BM05	BC05	AC02	CC02	2	0	3	1
540	ARTSIII	751320	3.0	3.2	3	I	15	RB41	BB08	RB03	BC05	CC01	AC01		1	5	3	1
541	ARTSIII	751315	3.0	3.2	2	I	56	BB01	BM05	RB03					8	0	3	1
542	ARTSIII	751310	3.0	3.2	2	I	56	RB44	BC03	RB03					1	5	3	1
545	ARTSIII	751220	3.0	3.2	2	I	56	BB01	BM06	RB03					9	5	4	1
546	ARTSIII	751225	3.0	3.2	2	I	56	AB20	BM06	BB01	RB03				4	0	4	1
549	ARTSIII	750490	3.0	3.2	2	I	56	AB16	BB01	BM04	RB03				4	0	2	1
553	ARTSIII	750300	3.0	3.2	2	I	21	AB26	BB01	BM05	AC03	JB01			2	0	1	1
555	ARTSIII	F21	5.4	6.8	2	0	50	BB04	CM08						9	5	0	1
556	ARTSIII	INV-1	5.4	6.8	2	0	50	BB04	CM05						9	5	1	1
557	ARTSIII	G22-1	5.4	6.8	2	0	50	BB04	CM05						9	5	1	1
558	ARTSIII	REG-1	5.4	6.8	2	0	50	BB12	CM24						9	5	2	1
559	ARTSIII	SRL-1	5.4	6.8	2	0	50	BB10	CM22						9	5	2	1
560	ARTSIII	GB1	5.4	6.8	2	0	50	BB04	CM07						9	5	1	2
561	ARTSIII	G2A-1	5.4	6.8	2	0	50	BB04	CM06						9	5	1	2
562	ARTSIII	G21	5.4	6.8	2	0	50	BB04	CM04						9	5	1	2
563	ARTSIII	RO-1	5.4	6.8	2	0	34	BB12	AB05	CM14	KB01				9	5	1	2
564	ARTSIII	GA1	5.4	6.8	2	0	50	BB04	CM04						9	5	1	2
565	ARTSIII	DEC-1	5.4	6.8	2	0	50	BB12	CM23						9	5	1	1
566	ARTSIII	CTR-1	5.4	6.8	2	0	50	BB10	CM19						9	5	2	1
567	ARTSIII	CMP	5.4	6.8	2	0	50	BB11	CM15						9	5	3	1
568	ARTSIII	BO-1	5.4	6.8	2	0	41	BB10	AB06	CB01	CM20	KB01			9	5	3	1
569	ARTSIII	SRS-1	5.4	6.8	2	0	50	BB12	CM26						9	5	3	1
570	ARTSIII	RDS-1	5.4	6.8	2	0	38	AB48	BB19	AC02	BC01	EL02	CM03	DC04	4	5	1	2
572	ARTSIII	IND	5.4	6.8	2	0	48	AB38	AC38						1	5	1	2
574	ARTSIII	SW	5.4	6.8	2	0	50	AB45	BB15						0	0	3	2
575	ARTSIII	BQ2-1	5.4	6.8	2	0	12	AB38	BB24	CM01	CL01	BH02	AC08	DC01	4	5	1	2

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SEQ NO.	EQPMT TITLE	ASS'Y NO.	BOARD LGTH	BOARD WDTH	# L	INOUT C	#TU	CP-1 ST#U	CP-2 ST#U	CP-3 ST#U	CP-4 ST#U	CP-5 ST#U	CP-6 ST#U	CP-7 ST#U	A D	R #	B #	G #
576	ARTSIII	BQ1	5.4	6.8	2	0	11	AB23	BB07	CB07	AC05	CL01	CC01	UD01	4	5	1	2
577	ARTSIII	RD4	5.4	6.8	2	0	36	AB12	BB12	CB01	CM03	CF01			3	5	2	1
578	ARTSIII	326523	4.1	5.7	2	0	35	AB52	BB06	AC11	CM16				6	5	0	1
579	ARTSIII	3265_09	4.1	5.7	2	0	33	AB_17	CM_{13}						9	5	0	1
58_0	ARTSIII	326520	4.1	5.7	2	0	34	AB62	AC_08	CM_{15}					7	5	0	1
581	ARTSIII	326521	4.1	5.7	2	0	8	AB14	CM19	AC02					9	5	0	1
582	ARTSIII	326526	4.1	5.7	2	0	35	AB35	AC03	CM21					4	5	0	1
583	ARTSIII	326530	4.1	5.7	1	0	32	AB60	AC_{10}	CM08	KB01				4	5	0	1
584	ARTSIII	326532	4.1	5.7	2	0	27	AB57	AC_17	CM_{11}	CB_04				6	5	0	1
585	ARTSIII	326536	4.1	5.7	2	0	32	AB54	BB_06	AC_{10}	CM_{13}				6	5	0	1
586	ARTSIII	326537	4.1	5.7	2	0	36	AB23	CM22						7	5	0	1
587	ARTSIII	DCM-1	6.0	6.0	2	0	69	AB52	BB28	CB16	CM10	BC08	AC05		4	5	1	1
588	ARTSIII	ADS	6.0	6.0	2	0	64	AB85	BB06	BC16	AC04	CM16			7	5	3	1
589	ARTSIII	CSM	6.0	6.0	2	0	55	AB46	BB24	CB_{12}	CC_02	BC26			2	0	3	1
59_0	ARTSIII	DCM	6.0	6.0	2	0	69	AB55	BB26	CB_{16}	CM_{11}	AC_05	BC_08		6	5	2	1
591	ARTSIII	DCM-2	6.0	6.0	2	0	69	AB49	BB26	CB16	CM11	AC05	BC08		6	5	3	1
592	ARTSIII	MTC	6.0	6.0	2	0	70	AB15	BB05	AC02	CM23	UP01			9	5	3	1
593	ARTSIII	UCM	6.0	6.0	2	0	60	AB10	BB03	CM24					9	5	1	1
594	ARTSIII	A_{1-1}	4.4	4.0	2	J	10	AB24	BB_{10}	CB_06	DB01	AC_01	BC_08		1	5	1	2
595	ARTSIII	686572	4.4	4.0	2	J	9	AB_{13}	BB_{10}	CB_{10}	AC_02	BC_06	DC_03	AA_02	1	5	0	2
596	ARTSIII	6865711	4.4	4.0	2	J	8	AB33	BB07	CB02	DB01	AC06	BC04	AA03	1	5	0	2
597	ARTSIII	A11-2	4.4	4.0	2	J	14	AB51	BB08	CB02	CC01	AC04	BC04	AA02	1	5	4	2
598	ARTSIII	686577	4.4	4.0	2	J	9	AB22	BB14	CB04	AC02	BC08	NB01		1	5	0	2
599	ARTSIII	7117500	3.0	5.0	2	I	44	AB45	BB04	CB01	AC04	BC04	CC02	HB01	1	5	5	1
6_{01}	ARTSIII	A3	4.0	8.0	2	U	31	AB_{26}	BB_{30}	CB_{10}	AC_04	BC_07	NC_{01}	HC_{01}	1	5	1	2
6_{02}	ARTSIII	A_{1-2}	5.8	5.0	2	A	19	AB57	BB45	CB_02	AC_05	BC_06	HC_05		1	5	4	1
6_{03}	ARTSIII	4334_04C	11.0	6.0	2	D	20	AB96	BB_08	BC_02	AC25	UF_{01}			1	5	0	1
6_05	ARTSIII	3223_05	4.5	4.0	1	2	17	AB_25	BB_09	AC_{01}	BC_03	CM_05	HC_{01}		2	5	0	1
606	ARTSIII	326510	3.5	5.1	2	C	12	AB02	BM14						9	5	0	1
607	ARTSIII	DISRECV	8.6	14.2	2	3	146	AB99	AB21	BB42	BM20	AC05	HC01		9	5	4	2
608	ARTSIII	EC149	4.0	2.5	1	B	10	AB13	BB05	CB02	BC04	CM02			1	5	0	2
6_09	ARTSIII	$XZ4_05$	4.0	2.5	1	C	14	AB_15	BB_03	CB_02	BC_03	HC_{01}			1	5	0	2
6_{10}	ARTSIII	A5-1	3.2	3.8	2	A	25	AB_08	RB22	DB_02	AA_04	CM_04			3	5	4	2
611	ARTSIII	SPECIAL	6.5	5.0	2	I	34	AB99	AB12	BB07	CB05	AC18	BC09	HC03	1	5	1	2
612	ARTSIII	2050	2.2	5.3	2	C	12	AB02	BB01	CM08	OA04				8	5	2	1
6_{13}	ARTSIII	233_0	2.2	5.3	2	C	14	AB_04	BB_{01}	CM_08	OA_05				8	5	2	1
6_{14}	ARTSIII	203_0	2.2	5.3	2	C	14	RB55	AB_08	CM_{02}	AC_09	CC_{01}	JF_{01}	OA_04	1	5	0	1
6_{15}	ARTSIII	288_0	2.2	5.3	2	C	7	AB_51	BB_09	CC_{01}	CM_{01}	AC_09	OA_{01}		2	5	0	1
616	ARTSIII	2270	2.2	5.3	2	C	18	RB57	CC04	AC12	OA04				2	5	0	1
617	ARTSIII	2010	2.2	5.3	2	D	13	RB48	BB03	CB04	CC02	AC09	BC01	EC01	1	5	0	1
618	ARTSIII	2020	2.2	5.3	2	D	21	RB40	BB06	CB03	CC01	AB10	BC01	EC01	1	5	0	1
6_{19}	ARTSIII	226_0	2.2	5.3	2	C	14	RB_28	BB_08	AC_06	JF_04	OA_04			1	5	0	1
62_0	ARTSIII	214_0	2.2	5.3	2	C	21	RB_28	CB_03	AC_04	BC_{01}	CM_{01}	TE_{01}	OA_04	1	5	0	1

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SEQ NO.	EQPMT TITLE	ASS'Y NO.	BOARD LGTH	BOARD WDTH	# L	INOUT C	#TU	CP-1 ST#U	CP-2 ST#U	CP-3 ST#U	CP-4 ST#U	CP-5 ST#U	CP-6 ST#U	CP-7 ST#U	A D	R #	B #	G #
621	ARTSIII	2060	2.2	5.3	2	C	20	AB24	BB01	AC02	CM08	OA06			4	0	2	1
622	ARTSIII	2040	2.2	5.3	2	C	17	AB23	CM08	OA06					4	5	3	1
623	ARTSIII	2130	2.2	5.3	2	C	18	AB05	CM06	OA05					8	5	4	1
624	ARTSIII	2180	2.2	5.3	2	C	13	AB50	BB04	CB02	CC01	CM02	AC08	OA04	1	5	1	1
625	ARTSIII	2230	2.2	5.3	2	C	13	AB03	CM07	OA11					7	5	4	1
626	ARTSIII	2320	2.2	5.3	2	C	6	AB30	BB06	AC07	OA02				2	5	4	2
627	ARTSIII	2150	2.2	5.3	2	C	9	AB41	BB06	AC08	CM01	CC01	OA08		1	0	4	2

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SEQ NO.	EQPMT TITLE	ASS'Y NO.	BOARD LGTH	BOARD WDTH	# L	INOUT C	#TU	CP-1 ST#U	CP-2 ST#U	CP-3 ST#U	CP-4 ST#U	CP-5 ST#U	CP-6 ST#U	CP-7 ST#U	A D	R #	B #	G #
629	REDE-6	WDF1	6.0	7.0	2	S	12	AB47	BB49	CB01	BC07	AC11	LF02	TC01	1	0	0	2
630	REDE-6	WVP1	6.0	7.0	2	S	29	AB99	AB39	BB02	BC57				1	0	0	2
631	REDE-6	WIR1	6.0	7.0	2	S	26	AB99	AB15	BB07	AC05	BC35			1	0	0	2
632	REDE-6	WVP2	6.0	7.0	2	S	27	AB99	AB39	BB09	AC08	BC29	DC01		1	0	0	2
633	REDE-6	WSG1	6.0	7.0	2	S	17	AB67	BB07	AC14	BC21	KF02	CB02		1	0	0	2
634	REDE-6	SSC1	6.0	7.0	2	S	11	AB61	BB03	CB11	RB26	AC07	BC16	KF03	1	0	0	2
635	REDE-6	RDF1	6.0	7.0	2	S	11	AB56	BB59	CB01	AC02	BC18	KF02	TC01	1	0	0	2
636	REDE-6	WDA1	6.0	7.0	2	S	13	AB43	BB16	CB02	BC12	YF01			1	0	0	2
637	REDE-6	SPM1	6.0	7.0	2	S	20	AB97	BB19	CB01	BC20				1	0	0	2
638	REDE-6	SFA1	6.0	7.0	2	S	22	AB48	BB17	CB03	AC05	BC12	KF02	TC02	1	0	0	2
639	REDE-6	SRD1	6.0	7.0	2	S	8	AB52	BB25	KB04	BC14	TC02			1	0	0	2
640	REDE-6	RVD1	6.0	7.0	2	S	13	AB77	BB11	CB07	BC17	YH01			1	0	0	2
641	REDE-6	RMG1	6.0	7.0	2	S	26	AB87	BB09	BC26	CB01	CM14			4	0	0	2
642	REDE-6	RHD1	6.0	7.0	2	S	13	AB76	BB22	BC22	JD02	HC02	TC02		1	0	0	2
643	REDE-6	8903HB2	12.4	9.5	2	T		AB48	BB45	CB10	BC14	AC02	HC01	TC07	1	0	0	2
644	REDE-6	8937127	12.0	9.5	2	T		AB99	AB99	JF01	BB80	BC52	FB02	CM02	2	0	3	2
645	REDE-6	8937128	12.0	9.5	2	T		AB99	AB23	BB81	CB03	JB03	TC12	BC25	1	0	3	2

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SEQ NO.	EQPMT TITLE	ASS'Y NO.	BOARD LGTH"	BOARD WDTH	# L	I C	NOUT #TU	CP-1 ST#U	CP-2 ST#U	CP-3 ST#U	CP-4 ST#U	CP-5 ST#U	CP-6 ST#U	CP-7 ST#U	A D	R #	B #	G #
646	MARKIB	KEYER	6.8	5.8	2	A	10	AB13	BB10	CB05	AC02	BC05	CC03	UH01	1	0	0	2
647	MARKIB	DCC 2-7	6.8	5.8	2	A	19	AB36	BB14	CB18	BC06	HC02	JF02	UB01	1	0	0	2
648	MARKIB	MONITER	6.8	5.8	2	A	6	AB37	BB14	CB08	BC09	UF01	LB01	CM03	4	3	0	2
649	MARKIB	IF/AGC	6.8	5.8	2	A	11	AB48	BB08	CB02	CL02	AC03	BC07	UJ01	1	3	2	2
650	MARKIB	ALARM	6.8	5.8	2	A	14	AB45	CB03	CF01	BC14	UD01	OA10		1	3	2	2
651	MARKIB	A1A3AFC	6.2	4.4	2	G	30	AB19	BB02	CB04	CC01	AA02	HH02		1	3	7	2
652	MARKIB	A1A2MOD	6.2	4.4	2	G	31	AB25	BB16	CB02	DC01	DH02	AA02	AC03	1	0	5	2
653	MARKIB	A1A1MON	6.2	4.4	2	G	33	AB79	BB07	BC02	DH05	AA04			1	0	0	2
654	MARKIB	MIXERIF	6.2	4.4	2	G	30	AB20	BB04	CB04	DH02				1	0	7	2
655	MARKIB	A2A1	5.7	5.0	2	3	28	AB39	BB11	BC11	DH02	TC02	AA04		1	1	0	2
656	MARKIB	BEACON	10.1	5.8	2	5	24	AB55	HC03	CB28	CC06	EB01	BC11	SH01	1	1	0	2
657	MARKIB	1A1A2	10.1	5.8	2	Z	13	AB95	BB06	CC03	BC19	OA07	KD02		1	0	0	2
658	MARKIB	A6A1	7.0	6.0	2	Q	8	AB99	AB19	BB22	CB02	EB02	CC02	AC35	1	0	3	2
659	MARKIB	A6A2	3.0	6.0	2	Q	13	AB37	BB02	CB01	AC08	BC05	JC02		1	0	0	2

PRINTED CIRCUIT BOARD EVALUATION

SEQ NO.	EQPMT TITLE	ASS'Y NO.	BOARD LGTH"	BOARD WDTH	# L	I C	NOUT #TU	CP-1 ST#U	CP-2 ST#U	CP-3 ST#U	CP-4 ST#U	CP-5 ST#U	CP-6 ST#U	CP-7 ST#U	A D	R #	B #	G #
661	WFMU	706499	2.5	8.8	2	6	128	RB64	OA99	OA93					1	0	0	1
662	WFMU	706540	2.5	4.0	2	E	30	AB11	AC10	CM03					6	5	0	1
663	WFMU	706526	2.5	4.0	2	E	59	BB01	CM06						9	5	0	1
664	WFMU	706530	2.5	4.0	2	E	60	BB01	CM06						9	5	0	1
665	WFMU	706528	2.5	4.0	2	E	60	BB01	CM05						9	5	0	1
666	WFMU	706551	2.5	4.0	2	E	23	AB54	AC12						1	0	0	1
667	WFMU	706549	2.5	4.0	2	E	44	AB11	BB02	DC01	CM03				9	5	2	1
668	WFMU	706607	2.5	4.0	2	E	14	BB02	CM05						9	5	0	1
669	WFMU	706542	2.5	4.0	2	E	55	AB12	CM01	DC01					3	5	0	1
670	WFMU	706534	2.5	4.0	2	E	19	AB29	BB06	CM03					3	5	0	1
671	WFMU	706532	2.5	4.0	2	E	14	AB22	BB02	CM02	AC01				4	5	0	1
672	WFMU	706538	2.5	4.0	2	E	16	AB37	BB07	AC04	CM01				4	5	0	1
673	WFMU	706536	2.5	4.0	2	E	17	AB34	BB06	AC05	CM02				3	5	0	1
674	WFMU	706544	2.5	4.0	2	E	20	OA60							1	5	0	1
675	WFMU	706546	2.5	4.0	2	E	60	AB20	BB04	BC04	CM02				5	5	1	1

PRINTED CIRCUIT BOARD EVALUATION

SEQ NO.	EQPMT TITLE	ASS'Y NO.	BOARD LGTH	BOARD WDTH	# L	# C	INOUT #TU	CP-1 ST#U	CP-2 ST#U	CP-3 ST#U	CP-4 ST#U	CP-5 ST#U	CP-6 ST#U	CP-7 ST#U	A D	R #	B #	G #
676	DIGITIZ	SRS	5.5	6.0	2	0	50	AB12	CM22						9	0	2	1
677	DIGITIZ	DEC	5.5	6.0	2	0	49	AB12	CM23						9	0	2	1
678	DIGITIZ	BFC	5.5	6.0	2	0	41	AB13	BB03	CB01	CM20	KB01			9	0	2	1
679	DIGITIZ	BO	5.5	6.0	2	0	26	AB09	CM22						9	0	2	1
680	DIGITIZ	ADDER	5.5	6.0	2	0	50	AB12	CM24						9	0	3	1
681	DIGITIZ	BU	5.5	6.0	2	0	50	AB06	CM10						9	5	2	1
682	DIGITIZ	REG	5.5	6.0	2	0	50	AB11	CM15						9	0	3	1
683	DIGITIZ	CMP	5.5	6.0	2	0	50	AB12	CM24						9	0	2	1
684	DIGITIZ	SRC	5.5	6.0	2	0	50	AB12	CM24						9	0	2	1
685	DIGITIZ	INV	5.5	6.0	2	0	50	AB04	CM05						9	5	2	1
686	DIGITIZ	FGM	5.5	6.0	2	0	32	AB04	CM08						9	5	1	1
687	DIGITIZ	F21	5.5	6.0	2	0	50	AB04	CM08						9	5	2	1
688	DIGITIZ	HA	5.5	6.0	2	0	11	AB04	CM05						9	5	2	1
689	DIGITIZ	G2A	5.5	6.0	2	0	50	AB04	CM06						9	5	2	1
690	DIGITIZ	EDT	5.5	6.0	2	0	50	AB11	CM20						9	0	2	1
691	DIGITIZ	DM	5.5	6.0	2	0	43	AB38	BB03	CM14	EF03	BH04			9	0	2	1
692	DIGITIZ	CUD	5.5	6.0	2	0	50	AB12	CM24						9	0	2	1
693	DIGITIZ	WS	5.5	6.0	2	0	49	AB04							1	0	1	2
694	DIGITIZ	C23	5.5	6.0	2	0	50	AB06	CM10						9	5	1	1
695	DIGITIZ	TL	5.5	6.0	2	0	50	AB02	BB01	CM16					9	5	1	1
696	DIGITIZ	CTR	5.5	6.0	2	0	50	AB10	CM19						9	0	2	1
697	DIGITIZ	C27	5.5	6.0	2	0	50	AB04	CM08						9	5	1	1
698	DIGITIZ	SRL	5.5	6.0	2	0	50	AB11	CM22						9	0	2	1
699	DIGITIZ	R6021	5.5	6.0	2	0	11	AB04	CM01						9	5	2	1
700	DIGITIZ	G22	5.5	6.0	2	0	50	AB04	CM05						9	5	2	1
701	DIGITIZ	G21	5.5	6.0	2	0	50	AB04	CM04						9	5	2	1
702	DIGITIZ	GB1	5.5	6.0	2	0	50	AB04	CM07						9	5	2	1
703	DIGITIZ	GA1	5.5	6.0	2	0	50	AB04	CM04						9	5	2	1
704	DIGITIZ	IRP	5.5	6.0	2	0	50	AB11	CM16						9	0	3	1
705	DIGITIZ	MLD	5.5	6.0	2	0	41	AB08	CM14						9	0	3	1
706	DIGITIZ	OPT	5.5	6.0	2	0	48	AB09	CM15						9	0	2	1
707	DIGITIZ	SYN	5.5	6.0	2	0	40	AB12	CM18						9	0	3	1
708	DIGITIZ	ST	5.5	6.0	2	0	49	AB47							1	0	1	1
709	DIGITIZ	DL	5.5	6.0	2	0	50	AB80	BB03	CM03	AC39	BC01	TO03		3	0	1	1
710	DIGITIZ	DC2	5.5	6.0	2	0	16	AB65	BB06	AC24	HJ01				1	0	1	1
711	DIGITIZ	BQ2	5.5	6.0	2	0	12	AB49	BB12	AC08	BH02	BJ01	CC01		2	0	2	2
712	DIGITIZ	BQ1	5.5	6.0	2	0	11	AB28	BB10	CC01	BJ01	AC05	UD01		1	0	2	2
713	DIGITIZ	BAM	5.5	6.0	2	0	15	AB21	BB04	CB04	CM06	AC07	BC01	XJ01	3	0	1	2
714	DIGITIZ	DAR	5.5	6.0	2	0	8	AB11	BB08	CB06	AC02	HC01	CC01		1	0	2	3
715	DIGITIZ	CCS	5.5	6.0	2	0	26	AB35	BB06	CB09	DB01	CD01	CM03	DC12	2	0	2	2

PRINTED CIRCUIT BOARD EVALUATION

SEQ NO.	EQPMT TITLE	ASS'Y NO.	BOARD LGTH	BOARD WDTH	# L	# C	INOUT #TU	CP-1 ST#U	CP-2 ST#U	CP-3 ST#U	CP-4 ST#U	CP-5 ST#U	CP-6 ST#U	CP-7 ST#U	A D	R #	B #	G #
716	DIGITIZ	RD1	5.5	6.0	2	0	25	AB25	BB06	CB06	CD02	CM02	BC04	LD01	4	0	1	2
717	DIGITIZ	LPD	5.5	6.0	2	0	46	AB21	AC17						1	0	2	2
718	DIGITIZ	IND	5.5	6.0	2	0	48	AB38	AC38	WQ01					1	0	1	2
719	DIGITIZ	EG	5.5	6.0	2	0	11	AB38	BB08	CB04	AC08	BC12			1	0	1	3
720	DIGITIZ	XYS	5.5	6.0	2	0	42	AB96	CB02	DD04	BC16	CM11			4	0	1	2
721	DIGITIZ	VR	5.5	6.0	2	0	46	AB45	BB05	CB06	DB01	CC05	BC12	SC02	1	0	1	2
722	DIGITIZ	DIG	5.5	6.0	2	0	43	AB37	CB04	BD04	BC04	CD04	CM09	UH01	4	0	1	2
723	DIGITIZ	DAS	5.5	6.0	2	0	29	AB88	AC33	BB04	CB02				2	0	1	2
724	DIGITIZ	RO	5.5	6.0	2	0	34	AB19	BB12	CB01	CM14	KB01	PB01		9	0	1	2
725	DIGITIZ	RA	5.5	6.0	2	0	17	AB23	BB05	CB02	CC02	BC03	CH01	JN01	1	0	1	3
726	DIGITIZ	SQ	5.5	6.0	2	0	24	AB68	BB03	CB03	CM01	BC05	CJ05	DC05	2	0	2	2
727	DIGITIZ	RD2	5.5	6.0	2	0	36	AB34	BB01	CB12	CM01	AC13			3	0	1	2
728	DIGITIZ	RD3	5.5	6.0	2	0	18	AB45	BB05	CB07	KB01	DC01	CD04	AC17	1	0	1	2
729	DIGITIZ	SW	5.5	6.0	2	0	50	AB45	BC15						2	0	4	2
730	DIGITIZ	ID	5.5	6.0	2	0	29	AB57	BB09	CB09	AC18				2	0	2	2
731	DIGITIZ	HOS	5.5	6.0	2	0	30	AB25	BB02	CB05	AC04	CM12			9	0	3	2

PRINTED CIRCUIT BOARD EVALUATION

SEQ NO.	EQPMT TITLE	ASS'Y NO.	BOARD LGTH	BOARD WDTH	# L	# C	INOUT #TU	CP-1 ST#U	CP-2 ST#U	CP-3 ST#U	CP-4 ST#U	CP-5 ST#U	CP-6 ST#U	CP-7 ST#U	A D	R #	B #	G #
732	IEM	SMS1	4.7	2.5	1	8	9	AB03	BB13	DB01	BC03	SC01			1	0	1	1
733	IEM	SMS2	4.7	2.5	1	8		AB20	BB05	AC05	CN02				1	0	0	1
734	IEM	SMS3	4.7	2.5	1	8		AB06	BB03	CB02	AC02	HC02			1	0	0	1
735	IEM	SMS4	4.7	5.2	1	8		AB44	BC12	CF01	CB04	BB06			1	0	0	1
736	IEM	SLT2	1.8	1.8	3	9		CN03							1	0	3	1
737	IEM	SLT5	3.0	7.0	2	9		AC32	WQ01						1	0	0	1

PRINTED CIRCUIT BOARD EVALUATION

SEQ NO.	EQPMT TITLE	ASS'Y NO.	BOARD LGTH	BOARD WDTH	# L	IN C	OUT #T	CP-1 ST#	CP-2 ST#	CP-3 ST#	CP-4 ST#	CP-5 ST#	CP-6 ST#	CP-7 ST#	A D	R #	B #	G #
741	ASR-7	651683	4.5	4.0	2	J	11	AB22	BB12	CB 9	BC 4	DC 2	C 1	D 1	2	5	5	2
742	ASR-7	651686	4.5	4.0	2	J	14	AB 9	BB 4	BC 5	DC 2	BA 4	DB 1		3	5	5	2
743	ASR-7	651692	6.4	8.0	2	U	22	CM20	AB 4	BB 1	DB 1	JJ 1			9	5	2	2
744	ASR-7	651695	6.4	8.0	2	U	39	CM 3	BA13	BC12	DB 2	BB27	AB99	AB 7	3	5	5	2
745	ASR-7	651698	6.4	8.0	2	U	16	CM 4	BC12	AC22	BA 9	DB 3	BB 7	AB56	8	5	1	2
746	ASR-7	651701	6.4	8.0	2	U	29	CM12	JJ 1	DB 1	BB 2	AB 8			9	5	2	2
747	ASR-7	651704	6.4	8.0	2	U	43	CM21	JJ 2	DB 1	BB 2	AB 4			9	5	2	2
748	ASR-7	651707	6.4	8.0	2	U	19	CM 9	BC14	DB 3	BA 4	AB63	BB33	DC 2	6	5	4	2
749	ASR-7	651716	6.4	8.0	2	U	8	BA 4	DC 1	BC14	CB 6	DB 2	BB15	AB43	2	5	5	2
750	ASR-7	651719	6.4	8.0	2	U	31	CM 9	BA 3	DB 3	BB 4	AB13	BC 2	JB 1	8	5	2	2
751	ASR-7	651728	6.4	8.0	2	U	38	CM16	JJ 1	BA 1	DB 1	BB 1	AB4		9	5	2	2
752	ASR-7	651731	6.4	8.0	2	U	35	CM21	BA10	DB 1	BB 1	AB			9	5	2	2
753	ASR-7	651734	6.4	8.0	2	U	10	DB 2	BC 1	DC 4	BB10	AB35	BA 3		2	5	5	2
754	ASR-7	651737	6.4	8.0	2	U	16	CM 4	DB 3	DC 1	BC 7	BB11	BA 5	AB47	4	5	4	2
755	ASR-7	651740	6.4	8.0	2	U	12	CM 1	BC 8	DC 3	DB 4	BA 4	BB26	AB39	2	5	4	2
756	ASR-7	651743	6.4	8.0	2	U	13	DC12	DB 4	BA 3	CB 3	BB26	AB82		6	5	4	2
757	ASR-7	651749	6.4	8.0	2	U	31	CM19	JJ 1	BA 3	DB 1	BB 1	AB 8		9	5	2	2
758	ASR-7	651833	4.5	4.0	2	J	11	DB 7	BA 6	DC 6	AB20	BC 9	BB37		1	5	2	2
759	ASR-7	651848	6.4	8.0	2	U	17	BA 9	DB11	BC16	DC 5	BB21	AB66		2	5	5	2
760	ASR-7	651863	6.4	8.0	2	U	14	BA 9	DC11	CM 1	BC20	AB11	BB20	AB99	3	5	4	2
761	ASR-7	651878	6.4	8.0	2	U	29	CM 8	BA 7	DC 3	BC10	BB 6	AB89		8	5	2	2
762	ASR-7	651904	6.4	8.0	2	U	10	CM 2	DC10	BC 9	BA 7	DB 3	BB28	AB42	2	5	5	2
763	ASR-7	651907	6.4	8.0	2	U	10	HB 1	DC 3	BB21	DE 5	BC26	AB79	CM 2	3	5	1	2
764	ASR-7	651910	6.4	8.0	2	U	11	BA 7	DC 3	BC24	BB33	AB77			2	5	4	2
765	ASR-7	651938	6.4	8.0	2	U	13	BA 3	DC12	CB20	BB 8	AB44			2	5	4	2
766	ASR-7	669430	6.4	8.0	2	U	22	CM14	BA 6	DB 1	BB 8	AB 3			9	5	0	2
767	ASR-7	669439	6.4	8.0	2	U	10	DC 6	BC16	DB 2	BB 8	AB79	BA 6		2	5	5	2
768	ASR-7	669442	6.4	8.0	2	U	7	DC 6	BC 5	DB 2	BA 4	BB16	AB55		1	5	5	2
769	ASR-7	669444	6.4	8.0	2	U	17	JJ 1	CM21	BA 1	DB 1	BB 6			9	5	1	2
770	ASR-7	669445	6.4	8.0	2	U	22	CM10	DC 2	BA 3	BC32	DB 3	BB35	AB95	3	5	3	2
771	ASR-7	669448	6.4	8.0	2	U	5	UH 1	BA 6	DC 7	DB 3	CB 6	BB 5	AB55	2	5	5	2
772	ASR-7	664518	6.4	8.0	1	U	5	UH 1	BA 2	DC 1	BC 3	DB 2	BB 5	AB22	1	5	0	2
773	ASR-7	664454	6.4	8.0	2	U	43	CM10	BA 4	DB 2	BC 3	BB11	AB44		7	5	1	2
774	ASR-7	664457	6.4	8.0	2	U	44	CM20	BA16	DB 1	BB 5				9	5	1	2
775	ASR-7	664460	6.4	8.0	2	U	26	CM17	BA 5	DB 1	BB 1	AB11			9	5	1	2
776	ASR-7	664463	6.4	8.0	2	U	5	JJ 2	BA 2	DC 2	DB 3	DC15	BB 3	AB86	2	5	0	2
777	ASR-7	664564	4.5	4.0	2	J	11	BA 4	DC 2	DB 3	BB13	AB 7	BC 2		1	5	5	2
778	ASR-7	664707	4.5	4.0	2	J	5	EC 4	BA 5	DC 2	DB 2	CB 4	BB 4	AB 4	1	5	5	2
779	ASR-7	707116	6.4	8.0	2	U	22	CM10	DC 2	BA 3	BC32	DB 3	BB35	AB95	3	5	3	2

APPENDIX C.

FAA CONTRACTOR INFORMATION

ATLANTIC RESEARCH CORPORATION
SHIRLEY MEMORIAL HIGHWAY AT EDSALL ROAD
ALEXANDRIA, VIRGINIA 22314 (703)354-3400

August 17, 1972

PHILCO-FORD CORP.
Comm. & Tech. Serv. Div.
3900 Welsh Road
Willow Grove, Pa. - 19090

Attn: G.L. Ginsberg
PCBS Prog. Mgr.

Subject: FAA P.C. Board Survey

Dear Mr. Ginsberg:

Atlantic Research Corp. will not be able to send a representative to the Study Phase meeting in San Francisco on Sept. 11.

The Teleproducts Dept. of ARC is actively engaged in the design and specification of printed circuit modules, the greater majority of these to commercial specifications. I have attached a copy of a general specification which we use for procurement of printed circuit boards.

Sincerely yours,
ATLANTIC RESEARCH CORPORATION
Wm K. Harding Jr.
William K. Harding, Jr.
Manager, Engineering Services
Teleproducts Department

WKH/sas
Encl.

DIMENSIONS ARE IN INCHES TOLERANCES: ANGLES ± FRACTIONS ± 2 PLACE DECIMALS ± 3 PLACE DECIMALS ± SURFACE ROUGHNESS √	REV	DESCRIPTION	DATE	BY	CHK	APPD
DO NOT SCALE DRAWING						

MAR 10 1972
TELEPRODUCTS DRAFTING

TP- SC-10554000

PRINTED CIRCUIT BOARD
FABRICATION REQUIREMENTS
CLASS 3

1.0 This document defines requirements for fabrication and acceptance of printed circuit boards, class 3.

2.0 In the event of a conflict between this standard and a purchase order, contract, or product drawing, the latter documents shall take precedence.

3.0 Material

Unless otherwise specified, material shall be .062 inch thick (nominal) 1 ounce copper clad, 2 sided, epoxy glass laminate, NEMA grade G10, or equivalent.

4.0 Plating

4.1 Class 3 boards will have the surface of the board and the walls of the holes plated with copper, .001" average thickness. Silver or graphite in any form shall not be used to sensitize holes in preparation for plating.

4.2 All connector and circuitry holes shall be plated thru.

APPROVAL	BY	DATE
DRAWN	S.A.S.	3-10-72
CHECKED		3-10-72
ENGRG		
PROJ ENGRG		3-10-72

ATLANTIC RESEARCH CORPORATION
A DIVISION OF THE SUSQUEHANNA CORP.
TELECOMMUNICATION PRODUCTS DEPT.
ALEXANDRIA, VIRGINIA 22314

PRINTED CIRCUIT BOARD
FABRICATION REQUIREMENTS - CLASS 3

SHEET 1 OF 3	SCALE: -	SIZE A	TP- SC-10554000	REV -

DIMENSIONS ARE IN INCHES TOLERANCES: ANGLES ± FRACTIONS ± 2 PLACE DECIMALS ± 3 PLACE DECIMALS ± SURFACE ROUGHNESS √	REV	DESCRIPTION	DATE	BY	CHK	APPD
DO NOT SCALE DRAWING						

TP- SC-10554000

4.3 Unless otherwise specified on the individual drawing, all terminal holes, hardware mounting holes, etc., may be optionally plated thru provided the finished hole size is as specified on the individual drawing.

4.4 The entire conductor surface of class 3 boards (except connector fingers) will be plated with 63/37 tin lead (solder plate) .0003" - .0008" thick. Fusion reflow is permissable after etching.

4.5 All contacts (connector fingers) will be plated with 200 to 500 micro-inches of nickel followed by an over-plate of 50 micro-inches minimum of hard gold per MIL-G-45204, Type II, Class 1, to a minimum dimension of .225 inches from edge of board.

5.0 Etching

5.1 The etching process shall assure the finished circuit pattern to be sharp and clearly defined, with no loss of characters on etched nomenclature.

5.2 Complete loss of plating in landless circuitry holes is not grounds for rejection of boards designed as landless plate thru.

APPROVAL	BY	DATE
DRAWN	S.A.S.	3-10-72
CHECKED	✓	3-10-72
ENGRG		
PROJ ENGRG	[illegible]	3-10-72

ATLANTIC RESEARCH CORPORATION
A DIVISION OF THE SUSQUEHANNA CORP.
TELECOMMUNICATION PRODUCTS DEPT.
ALEXANDRIA, VIRGINIA 22314

PRINTED CIRCUIT BOARD
FABRICATION REQUIREMENTS - CLASS 3

SHEET 2 OF	SCALE: -	SIZE A	TP- SC- 10554000	REV -

DIMENSIONS ARE IN INCHES TOLERANCES: ANGLES ± FRACTIONS ± 2 PLACE DECIMALS ± 3 PLACE DECIMALS ± SURFACE ROUGHNESS √	REV	DESCRIPTION	DATE	BY	CHK	APPD
DO NOT SCALE DRAWING						

TP- SC-10554000

6.0 Machining

6.1 Boards will be fabricated and inspected to the dimensions called out on the individual drawing.

6.2 All fillet radii will be .062 or less.

6.3 All external radii will be .250 or less.

6.4 All requirements for connector keying slots shall be deleted.

6.5 Board edges shall be smooth and there shall be no evidence of lifted circuitry upon completion of all machining operations.

APPROVAL	BY	DATE
DRAWN	S.A.S.	3-10-72
CHECKED	✓	3-10-72
ENGRG		
PROJ ENGRG	[illegible]	3-10-72

ATLANTIC RESEARCH CORPORATION
A DIVISION OF THE SUSQUEHANNA CORP.
TELECOMMUNICATION PRODUCTS DEPT.
ALEXANDRIA, VIRGINIA 22314

PRINTED CIRCUIT BOARD
FABRICATION REQUIREMENTS - CLASS 3

SHEET 3 OF	SCALE: -	SIZE A	TP- SC- 10554000	REV -

SR SYSTEMS

Scientific Radio Systems Inc. 367 Orchard Street, Rochester, New York 14606

August 21, 1972

Philco Ford Corp.
3900 Welsh Road
Willow Grove, Pennsylvania 19090

Attention: Mr. G. L. Ginsberg, PCBS Program Manager

Dear Mr. Ginsberg:

This is in reply to your letter of 3 August 1972 with regards to the PCBS program. Since we will not be at the San Francisco meeting, I'll send you information on our printed circuit boards as supplied in equipment provided to the FAA.

Sincerely,

Neal E. Garman
Manager
Government Marketing

NEG:jv

Cable: SIRAD, Rochester, N.Y. **Telephone:** Area 716 458-3733

ELECTRONIC LABORATORIES INC

3726 DACOMA ST. ● AC 713 / 686-8656 ● HOUSTON, TEXAS 77018

August 17, 1972

Philco-Ford Corporation
Communications and Technical
Services Division
3900 Welsh Road
Willow Grove, Penn. 19090

Attn: Mr. G. L. Ginsberg, PCBS Program Manager

Dear Sir:

Subject: Participation in Study Phase of FAA Printed Circuit Board Survey

E.L.I. is interested in attending the subject meeting on 11 September 1972. As an FAA contractor we have had some experience with the problems encountered in providing P.C. Boards acceptable to the FAA.

Our printed circuit boards are of high density design and are manufactured to MIL-P-55110A, except that minimum spacing requirements have been relaxed to .015 inches. All boards are double-sided, utilizing plated-thru-holes for interfacial connections.

Our major problem areas have been in the areas of measling and crazing due to either deficient base material or excessive heat during soldering of the P.C. board assemblies.

Another problem area is the requirement that all holes contain a continuous solder plug. This problem is presently under investigation, and we will be happy to discuss the outcome with your office. We presently hand-solder all boards on the FAA contract because of the physical size and lack of success in wave soldering without base material damage.

We are enclosing a print of a typical P.C. board used in the FAA equipment which we are presently producing.

Sincerely,

ELECTRONIC LABORATORIES, INC.

Paul H. Bailey

Paul H. BAiley
Q. A. Manager

APPENDIX D

FAA EQUIPMENT INFORMATION

Date Completed 16-OCT-72
Roger A. Kelb (Sr. Tech)
P.C. Layout - circuit design

QUESTIONAIRE

EQUIPMENT: Doppler VOR Sideband Antenna Monitor (FA-8142)

VENDOR: Chain Lakes Research Corporation CHAIN
(Use additional sheets if required.)

BACKGROUND INFORMATION

1. What specifications were originally envoked which directly affected P.C. board size? Cabinet size

2. What other specifications or equipment requirement affected P.C. board size? Required to be easily charged or serviced

3. To what extent did the utilization of maximum equipment cabinet volume influence P. C. board size? 100%

4. Were vendor Standards used for P.C. board sizes?
No

5. What factors were dominant in P.C. board size determination?
Primarily cabinet size versus large numbers of discrete components

6. What specifications or other requirements affected P.C. board connector selection?
At the time the present spec was not in effect — we used the foils with gold plate as connector plugs

7. Were the equipment and/or P.C. boards "off-the-shelf"?
No - They were designed here at CLRC

8. Was any new tooling (fabrication and/or test) required for these P.C. boards?
Yes - Tooling was made up by vendor (I.T.T. in Fort Wayne, Ind)

9. What was the approximate quantity of P.C. boards (by type) in the first procurement? 250 boards

DOPPLER VOR Sideband Antenna Monitor

EFFECT OF P.C. BOARD SIZE RESTRICTION AT TIME OF PROCUREMENT

(3 x 4-1/2 inches maximum - connector or tang on 3 inch side)

Design and Documentation

P.C. Board (Partitioning, layout, backpanel)

(1) Conductors would have to have been smaller than desired - (1/16" WIDE USED)
(2) Components would have been crowded
(3) Nomenclature on the top of the board would have been nearly impossible or unreadable
(4) Discrete parts circuit would have been impossible

Equipment (Interconnections, card rack)

New type of connectors could have been used.

Manufacturing

Material (Laminate, connectors, card rack, backpanel cabinets)

1/16" G-10 — 22 pin gold plated tabs
2 oz tin plated copper

Fabrication (Board blank, auto insertion, backpanel)

5 x 5 1/2 board ~~with~~ (1/2 big plug)

Test (Interface, fault isolation, facility complexity)

Our layout - was satisfactory

Maintenance

Troubleshoot and Repair (Fault isolation to a P.C.B., to a component)

All - No runs on component side - all holes were plated through. Repair was very easy.

Logistics (Spares reprocurement)

We bought 250 spare boards about one-year later.

Performance

Electrical (Consistency and absolute)

I.T.T. boards were excellent for our needs

Mechanical (Ruggedness)

Design problem - ground paths were too wide, they needed to be taken up in width, boards warped during machine soldered.

Reliability (Number and types of interconnections)

Excellent

RAYTHEON

RAYTHEON COMPANY
EXECUTIVE OFFICES

141 SPRING STREET
LEXINGTON, MA 02173

TEL: 617-862-6600
CABLE: RAYTHEONEX
TELEX: 92-3455

October 17, 1972

Mr. Donald L. Ware
Senior Engineering Specialist
Advanced Systems and Technology
Communications and Technical Services Division
Philco-Ford Corporation
3900 Welsh Road
Willow Grove, Pennsylvania 19090

Dear Mr. Ware:

The Printed Circuit Board Survey Questionnaire which you recently sent to my attention has been forwarded to Mr. Harold M. Hart at our Equipment Division Headquarters in Wayland, Massachusetts.

Mr. Hart has the technical responsibility for FAA contract work presently being performed at Raytheon. Further correspondence regarding the questionnaire should be directed to Mr. Hart or his designee.

Very truly yours,

James K. Rogers

James K. Rogers, Manager
Environmental Quality

cc: H. M. Hart

Date Completed 10-20-72

QUESTIONAIRE

EQUIPMENT: Coded Time Source (FA-7951)

VENDOR: Electronic Labs Inc. (Houston, Texas)
(Use additional sheets if required.)

BACKGROUND INFORMATION

1. What specifications were originally envoked which directly affected P.C. board size? Contract specification dictating the available volume and dimension and subdivision of the system.

2. What other specifications or equipment requirement affected P.C. board size? Restriction due to the initial configuration of R.D. Package

3. To what extent did the utilization of maximum equipment cabinet volume influence P. C. board size?

   Location and Front Panel layout

4. Were vendor Standards used for P.C. board sizes?

   Yes

5. What factors were dominant in P.C. board size determination?

   Standard connector size, card rack and card guide

6. What specifications or other requirements affected P.C. board connector selection?

   Circuit complexity, I/O access

7. Were the equipment and/or P.C. boards "off-the-shelf"?

   No

8. Was any new tooling (fabrication and/or test) required for these P.C. boards?

   No

9. What was the approximate quantity of P.C. boards (by type) in the first procurement?

   35 Types - Total of 228 boards per system

CODED TIME SOURCE

EFFECT OF P.C. BOARD SIZE RESTRICTION AT TIME OF PROCUREMENT
(3 x 4-1/2 inches maximum - connector or tang on 3 inch side)

Design and Documentation

P.C. Board (Partitioning, layout, backpanel)

Equipment (Interconnections, card rack) ✓

Manufacturing

Material (Laminate, connectors, card rack, backpanel cabinets)

Fabrication (Board blank, auto insertion, backpanel)

Test (Interface, fault isolation, facility complexity)

Maintenance

Troubleshoot and Repair (Fault isolation to a P.C.B., to a component)

Logistics (Spares reprocurement) ✓

Performance

Electrical (Consistency and absolute)

Mechanical (Ruggedness)

Reliability (Number and types of interconnections) ✓

Date Completed 10/23/72

B. J. Olson
M.S. 1441
SPERRY RAND CORPORATION

QUESTIONAIRE

EQUIPMENT: Automated Radar Terminal System (ARTS-III)

VENDOR: Univac Defense Systems Division) UNIVAC PARK, P.O. BOX 3525, ST. PAUL, MINNESOTA 5510

(Use additional sheets if required.)

BACKGROUND INFORMATION

1. What specifications were originally envoked which directly affected P.C. board size?

   MIL-STD-275 & Heat Dissipation.

2. What other specifications or equipment requirement affected P.C. board size?

   Above & cabinet size.

3. To what extent did the utilization of maximum equipment cabinet volume influence P. C. board size?

   Largely.

4. Were vendor Standards used for P.C. board sizes?

   Only in connector area.

5. What factors were dominant in P.C. board size determination?

   Positions for max. 20 (14) lead flat paks & (3) layers.

6. What specifications or other requirements affected P.C. board connector selection?

   Pin requirement.

7. Were the equipment and/or P.C. boards "off-the-shelf"?

   No.

8. Was any new tooling (fabrication and/or test) required for these P.C. boards?

   Yes.

9. What was the approximate quantity of P.C. boards (by type) in the first procurement?

   75 types.

AUTOMATED RADAR TERMINAL SYSTEM

EFFECT OF P.C. BOARD SIZE RESTRICTION AT TIME OF PROCUREMENT

(3 x 4-1/2 inches maximum - connector or tang on 3 inch side)

Design and Documentation

P.C. Board (Partitioning, layout, backpanel)

New

Equipment (Interconnections, card rack)

New

Manufacturing

Material (Laminate, connectors, card rack, backpanel cabinets)

New

Fabrication (Board blank, auto insertion, backpanel)

New

Test (Interface, fault isolation, facility complexity)

New

Maintenance

Troubleshoot and Repair (Fault isolation to a P.C.B., to a component)

--

Logistics (Spares reprocurement)

--

Performance

Electrical (Consistency and absolute)

None

Mechanical (Ruggedness)

None

Reliability (Number and types of interconnections)

None

COLLINS RADIO COMPANY • CEDAR RAPIDS

COLLINS

Cedar Rapids, Iowa 52406 Area Code 319 395-1000 Cable: COLINRAD

25 October 1972

Mr. Donald L. Ware
Senior Engineering Specialist
Advanced Systems and Technology
PHILCO-FORD CORPORATION
3900 Welsh Road
Willow Grove, Pennsylvania 19090

Dear Mr. Ware:

I received your letter of 13 October requesting information as to the circuit board content of two of our equipments. The equipments in question are the TV-36 and TU-9, which is a 50 watt VHF/UHF Transmitter and contains no circuit cards in its present configuration.

I suggest that any information on planar content within the various boxes sold to the FAA be secured from the FAA as our design criteria is proprietary in nature and we discuss only with our customer.

Very truly yours,

COLLINS RADIO COMPANY

W. J. Hess

W. J. Hess
Director of Marketing
Industrial Products

WJH:je

RAYTHEON COMPANY
EQUIPMENT DIVISION

EQUIPMENT DEVELOPMENT LABORATORIES
528 BOSTON POST ROAD
SUDBURY, MA 01776

TEL: 617-443-9521
TWX: 710-347-0384
TELEX: 94-8422

IBG:047
27 November 1972

Philco-Ford Corporation
Communications and Technical Services Division
3900 Welsh Road
Willow Grove, Pennsylvania 19090

Attention: Mr. Donald L. Ware

Gentlemen:

The enclosed questionnaires have been completed to the spirit of your letter dated 13 October 1972. Your letter was referred to me by Mr. Ted Spotswood since the questions were directed to my program.

If you desire any further information, feel free to contact the writer.

Very truly yours,

RAYTHEON COMPANY

IB Goldberg

Irving B. Goldberg
Assistant Program Manager
Computer Display Channel Program

Date Completed 11/14/72

QUESTIONAIRE

EQUIPMENT: Radar Brite Display Equipment - RBDE-5 (FA-2449)

VENDOR: Raytheon, Lexington, Mass.

(Use additional sheets if required.)

BACKGROUND INFORMATION

1. What specifications were originally envoked which directly affected P.C. board size?

   None

2. What other specifications or equipment requirement affected P.C. board size?

   None

3. To what extent did the utilization of maximum equipment cabinet volume influence P. C. board size?

   No impact

4. Were vendor Standards used for P.C. board sizes?

   No

5. What factors were dominant in P.C. board size determination?

   Raytheon Wayland Laboratory standard at that time

6. What specifications or other requirements affected P.C. board connector selection?

   MIL-STD-275A

7. Were the equipment and/or P.C. boards "off-the-shelf"?

   No

8. Was any new tooling (fabrication and/or test) required for these P.C. boards?

   Amp tool for staking the Amp blade connectors (29 pin) to PCB

9. What was the approximate quantity of P.C. boards (by type) in the first procurement?

   Number of different types: approximately 112
   Quantity of each type: from 1 to 64
   Total quantity: approximately 550/system

EFFECT OF P.C. BOARD SIZE RESTRICTION AT TIME OF PROCUREMENT

(3 x 4-1/2 inches maximum - connector or tang on 3 inch side)
6" X 5-1/8" with 29 pin connector on 5-1/8" end

Design and Documentation

P.C. Board (Partitioning, layout, backpanel)

211 design layouts, PCB detail, master pattern 24, assembly drawing, P/L, schematic

Equipment (Interconnections, card rack)

Card Racks

Manufacturing

Material (Laminate, connectors, card rack, backpanel cabinets)

Laminate - 1/10 thk, 2oz copper clad, single & double sided, G10 epoxy glass cloth

Fabrication (Board blank, auto insertion, backpanel)

Blank PCB's designed for Auto insertion

Test (Interface, fault isolation, facility complexity)

PCB test points (maximum of 9/PCB)

Maintenance

Troubleshoot and Repair (Fault isolation to a P.C.B., to a component)

to PCB level

Logistics (Spares reprocurement)

10% spares

Performance

Electrical (Consistency and absolute)

No known bad history

Mechanical (Ruggedness)

No known bad reports

Reliability (Number and types of interconnections)

Plug-in PCB, crimp type contacts of poke-home variety

Date Completed 11/14/72

QUESTIONAIRE

EQUIPMENT: Computer Display Channel - CDC/CUE (FA-7900/7919)

VENDOR: Raytheon Company, Lexington, Mass.
(Use additional sheets if required.)

BACKGROUND INFORMATION

1. What specifications were originally envoked which directly affected P.C. board size?
   Internal outline sizes used with attention to I/O quantities - connector types defined in FAA specification by similarity and MIL-STD-275A.
2. What other specifications or equipment requirement affected P.C. board size?
   Component derating requires versus cabinet volume available

3. To what extent did the utilization of maximum equipment cabinet volume influence P. C. board size?
   To a large extent - larger board reduces connector volume and interconnecting cable quantity

4. Were vendor Standards used for P.C. board sizes?

   Only as related to connector size availability

5. What factors were dominant in P.C. board size determination?
   Reduction of I/O pins, provision for proper sizing of power, electrical function/board thus minimizing types of different boards
6. What specifications or other requirements affected P.C. board connector selection?
   Density of I/O pins, WW capability
   crimp/poke-home capability, cost and MIL-STD-275

7. Were the equipment and/or P.C. boards "off-the-shelf"?

   No

8. Was any new tooling (fabrication and/or test) required for these P.C. boards?
   Routing fixture, test equipment for electrical test and PCB Tester designed for field maintenance

9. What was the approximate quantity of P.C. boards (by type) in the first procurement?
   CUE: approximately 13,200 of 23 different types
   CDC: total of approximately 20,000 boards of 50 different types

EFFECT OF P.C. BOARD SIZE RESTRICTION AT TIME OF PROCUREMENT

(3 x 4-1/2 inches maximum - connector or tang on 3 inch side)

Design and Documentation

P.C. Board (Partitioning, layout, backpanel)

Smaller functions ∴ more I/O to handle, less electronics/volume
Results in fewer large function boards

Equipment (Interconnections, card rack)

Increases costs since more (but smaller) items are required.
Interconnection (by hand or WW) is more expensive and more change for error than when committed to artwork master pattern.

Manufacturing

Additional I/O connections decreases reliability.

Material (Laminate, connectors, card rack, backpanel cabinets)

Cost goes up due to increased quantity of cards, racks, interconn & cabinet test/debug.

Fabrication (Board blank, auto insertion, backpanel)

--

Test (Interface, fault isolation, facility complexity)

More units using simpler test but much more complex cabinet test required

Maintenance

Troubleshoot and Repair (Fault isolation to a P.C.B., to a component)

Must be easier, but much harder to isolate an electrical function

Logistics (Spares reprocurement)

Pushes closer to throw away unit since PCB cost is lower

Performance

Electrical (Consistency and absolute)

o.k. if all delays are considered in the design

Mechanical (Ruggedness)

often by compromising accessibility, packaging density, and increasing total manufacturing cost

Reliability (Number and types of interconnections)

Poor - miniaturization of electronics over past few years has not included interconnections

Date Completed January 25, 1973

QUESTIONAIRE

WILCOX ELECTRIC, INC. 14th and Chestnut Kansas City, Missouri 64127 A Subsidiary of Northrop Corporation

EQUIPMENT: Localizer Station/Instrument Landing System - Mark IA (FA-8000)

VENDOR: Wilcox (Kansas City, Missouri)
(Use additional sheets if required.)

BACKGROUND INFORMATION

1. What specifications were originally envoked which directly affected P.C. board size?

None

2. What other specifications or equipment requirement affected P.C. board size? Equipment configuration and circuit functions are the determining factors.

3. To what extent did the utilization of maximum equipment cabinet volume influence P. C. board size? Equipment volume was instrumental in determining size of individual pull-out units which, in turn, was instrumental in determining P.C. board size.

4. Were vendor Standards used for P.C. board sizes?

No

5. What factors were dominant in P.C. board size determination? Circuit functional divisions and unit size.

6. What specifications or other requirements affected P.C. board connector selection? FAA-G-2100 MIL-STD-275 (Specs. dictated type more than size of connector.

7. Were the equipment and/or P.C. boards "off-the-shelf"?

No

8. Was any new tooling (fabrication and/or test) required for these P.C. boards?

Yes

9. What was the approximate quantity of P.C. boards (by type) in the first procurement? Approximately 50

EFFECT OF P.C. BOARD SIZE RESTRICTION AT TIME OF PROCUREMENT

(3 x 4-1/2 inches maximum - connector or tang on 3 inch side)

Design and Documentation

P.C. Board (Partitioning, layout, backpanel)

Require more drafting time to document. Would tend to entice one to standardize on size (3 x 4-1/2 is a small board size).

Equipment (Interconnections, card rack)

Require more time to package.

Manufacturing

Material (Laminate, connectors, card rack, backpanel cabinets)

Require documentation and stocking of different connector size.

Fabrication (Board blank, auto insertion, backpanel)

Require more part numbers in inventory, more handling.

Test (Interface, fault isolation, facility complexity)

Require more test operations.

Maintenance

Troubleshoot and Repair (Fault isolation to a P.C.B., to a component)

Should be easier to troubleshoot.

Logistics (Spares reprocurement)

More handling, higher cost, more storage.

Performance

Electrical (Consistency and absolute)

Depends on type of circuitry, but could conceivably cause higher inductive paths, crosstalk, and impedance between circuits.

Mechanical (Ruggedness)

Would be more rigid, would definitely use 1/16" thick material instead of 3/32" material.

Reliability (Number and types of interconnections)

More interconnections; hence, more likely to have failures.

General--Recommend a larger board for ground equipment applications, like 4-1/2 x 6 with connector on either side.

Date Completed January 25, 1973

QUESTIONAIRE

EQUIPMENT: VHF 8-Watt Transmitter (TV-35)

VENDOR: Wilcox Electric (Kansas City, Missouri)
(Use additional sheets if required.)

BACKGROUND INFORMATION

1. What specifications were originally envoked which directly affected P.C. board size?

None

2. What other specifications or equipment requirement affected P.C. board size? Equipment configuration and circuit functions are the determining factors.

3. To what extent did the utilization of maximum equipment cabinet volume influence P. C. board size? Equipment volume was instrumental in determining size of individual pull-out units which, in turn, was instrumental in determining P.C. board size.

4. Were vendor Standards used for P.C. board sizes?

No

5. What factors were dominant in P.C. board size determination?

Circuit functional divisions and unit size.

6. What specifications or other requirements affected P.C. board connector selection? FAA-G-777 This spec preceded FAA-G-2100 and did not reference Military Specs relating to P.C. boards. This unit is an old design and is not representative of the state-of-the-art.

7. Were the equipment and/or P.C. boards "off-the-shelf"?

No

8. Was any new tooling (fabrication and/or test) required for these P.C. boards?

Yes

9. What was the approximate quantity of P.C. boards (by type) in the first procurement? Approximately 5

EFFECT OF P.C. BOARD SIZE RESTRICTION AT TIME OF PROCUREMENT

(3 x 4-1/2 inches maximum - connector or tang on 3 inch side)

Design and Documentation

P.C. Board (Partitioning, layout, backpanel)

Require more drafting time to document. Would tend to entice one to standardize on size (3 x 4-1/2 is a small board size).

Equipment (Interconnections, card rack)

Require more time to package.

Manufacturing

Material (Laminate, connectors, card rack, backpanel cabinets)

Require documentation and stocking of different connector size.

Fabrication (Board blank, auto insertion, backpanel)

Require more part numbers in inventory, more handling.

Test (Interface, fault isolation, facility complexity)

Require more test operations.

Maintenance

Troubleshoot and Repair (Fault isolation to a P.C.B., to a component)

Should be easier to troubleshoot.

Logistics (Spares reprocurement)

More handling, higher cost, more storage.

Performance

Electrical (Consistency and absolute)

Depends on type of circuitry, but could conceivably cause higher inductive paths, crosstalk, and impedance between circuits.

Mechanical (Ruggedness)

Would be more rigid, would definitely use 1/16" thick material instead of 3/32" material.

Reliability (Number and types of interconnections)

More interconnections; hence, more likely to have failures.

General--Recommend a larger board for ground equipment applications, like 4-1/2 x 6 with connector on either side.