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TASK 2 - FLIGHT PROTOTYPE SYSTEM DESIGN REPORT

Pulsed Plasma Solid Propellant Microthruster for the Synchronous Meteorological Satellite

Interim Report for Period
November 1971-April 1972

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Fairchild Republic Division Farmingdale, New York 11735

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Pulsed Plasma Solid Propellant Microthruster for the Synchronous Meteorological Satellite

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16. Abstract

This report presents design details of the solid propellant pulsed plasma microthruster which was analyzed during the Task I effort. The design details presented shows that the inherent functional simplicity underlying the flight proven LES-6 design can be maintained in the SMS system design even with minimum weight constraints imposed. A 1293 hour uninterrupted vacuum test with the engineering thermal model simulating an 18.8 to 33 g environment of the propellant, its feed system and electrode assembly revealed that program thruster performance requirements could be met. This latter g environment is a more severe environment than will be ever encountered in the SMS spacecraft.

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PREFACE

This report presents the results performed during Task 2 of the program. It presents the design and efforts supporting the design of the flight prototype solid propellant pulsed plasma propulsion system. The period of performance covered is from November 1971 to April 1972. The design effort contributions during this period of performance were primarily provided by the joint efforts of Messrs. G. Schweitzer and Mr. Katchmar at Fairchild Industries. The design efforts of the Power Conditioner were under the directionof Dr. E. T. Moore of Wilmore Electronics, Inc. The entire program was under the direction of Dr. W. J. Guman.

The results presented herein have shown that inherent functional simplicity underlying the flight proven LES-6 design can be maintained in the SMS system design even with minimum weight constraints imposed. Furthermore, a 1293 hour uninterrupted test with the engineering thermal model simulating an 18.8 to 33 g environment of the propellant, its feed system and electrode assembly revealed that program thruster performance requirements could be met. This latter g environment is a more severe environment than will be encountered on the spacecraft.

The material presented in this report primarily describes the system design by reference to corresponding tentative drawings provided.

CONTENTS

ILLUSTRATIONS

ILLUSTRATIONS (Cont'd)

ILLUSTRATIONS (Cont'd)

1.0 INTRODUCTION

This Task 2 report presents details of the thruster and power conditioner design whose analysis was presented in Reference 1.

Since the major part of the Task 2 effort was concerned with the system design, this report will be primarily comprised of the tentative drawings of the components of the design that were produced during the Task 2 design effort. Besides the drawings, presented in Appendix C, a relatively large number of specifications were also written for in-process testing of subassemblies to be fabricated. Rather than presenting these latter specification documents in this report, they are presented by title in tabular form in Appendix A with one sample presented as Appendix B.

Some supplementary supporting studies were also performed in conjunction with the final design and the results of these latter studies are presented in Section 4 of this report. Sections 2 and 3 present details of the design of the thruster and power conditioner, respectively.

Because the propulsion system is comprised of many components, it is necessary to present a discussion of the system in some orderly manner. Figure 1 presents a breakdown of the propulsion system in terms of major assemblies and then subsequent subassemblies. The description of the design will be presented in a manner which follows the layout presented in Figure 1.

1.1 BRIEF DESCRIPTION OF MAJOR OVERALL SUBASSEMBLY

Figure 2 schematically presents the complete propulsion system. Figure 3 shows an engineering model of the thruster without the power conditioner. Relevant callouts are provided to locate major components and subassemblies. Fundamentally, the propulsion system is comprised of two major subassemblies:

a) The thruster subassembly, and
b) The converter-charger subassembly.

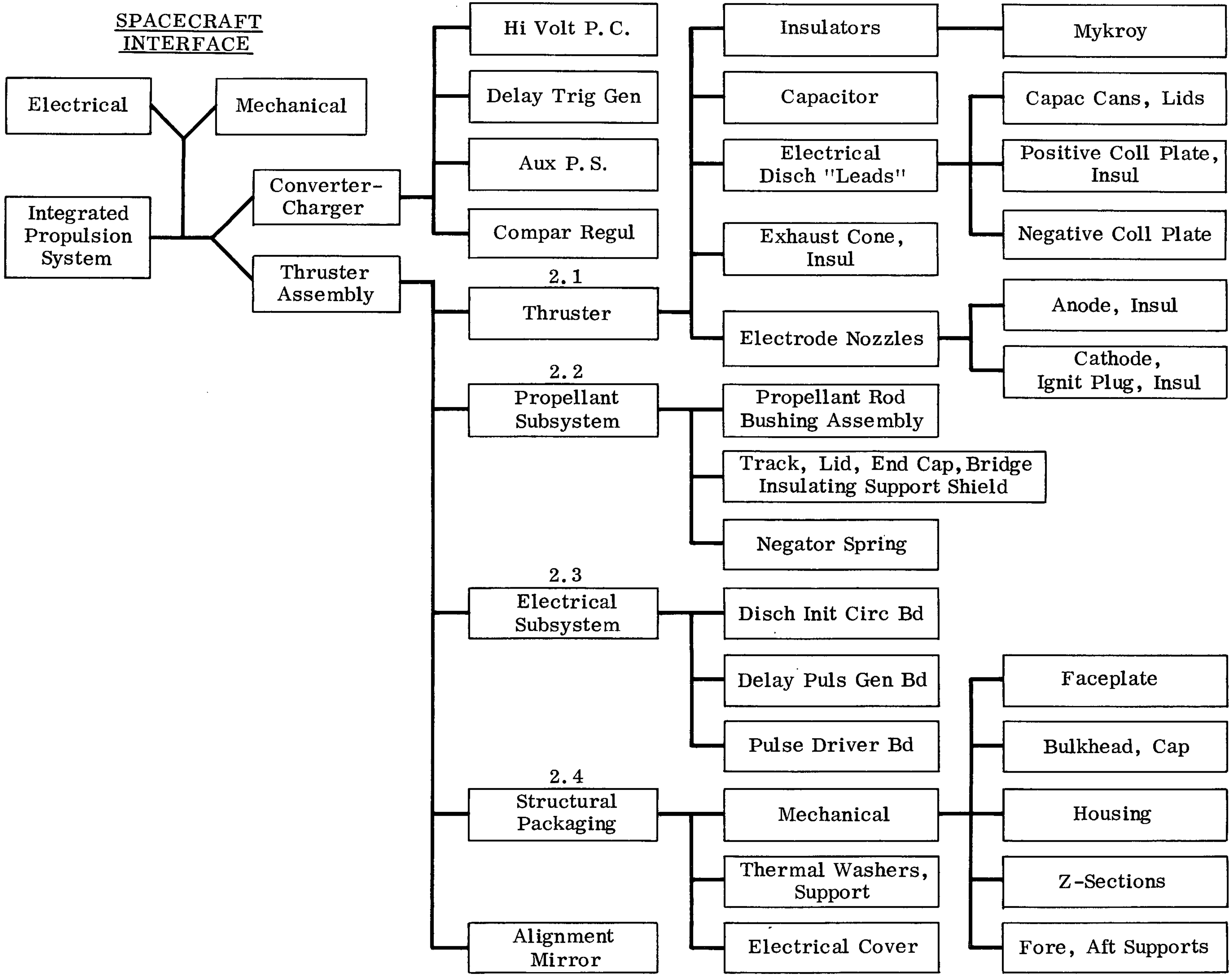

Figure 1. Propulsion System Assembly and Subassemblies

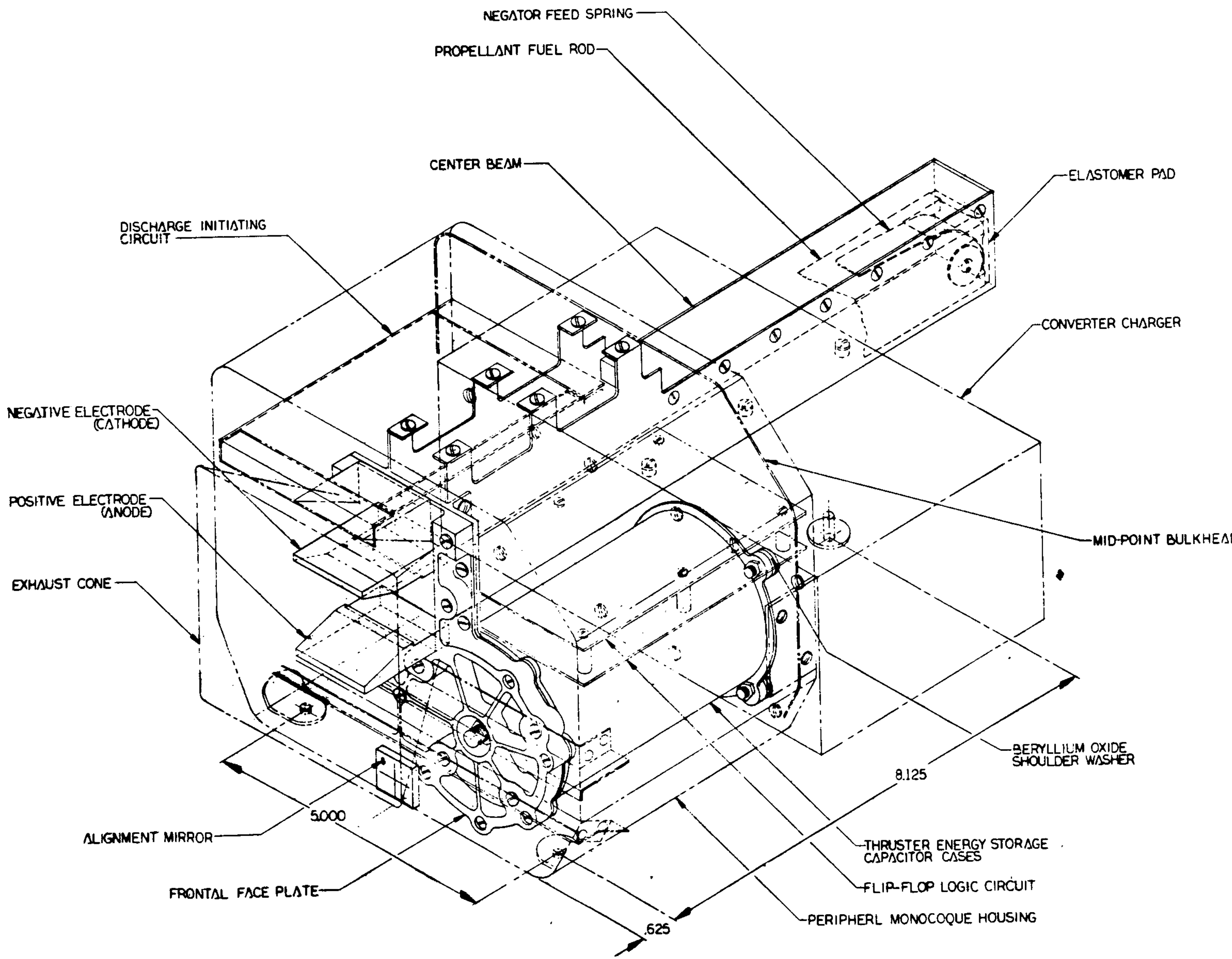

Figure 2. Schematic of Propulsion System

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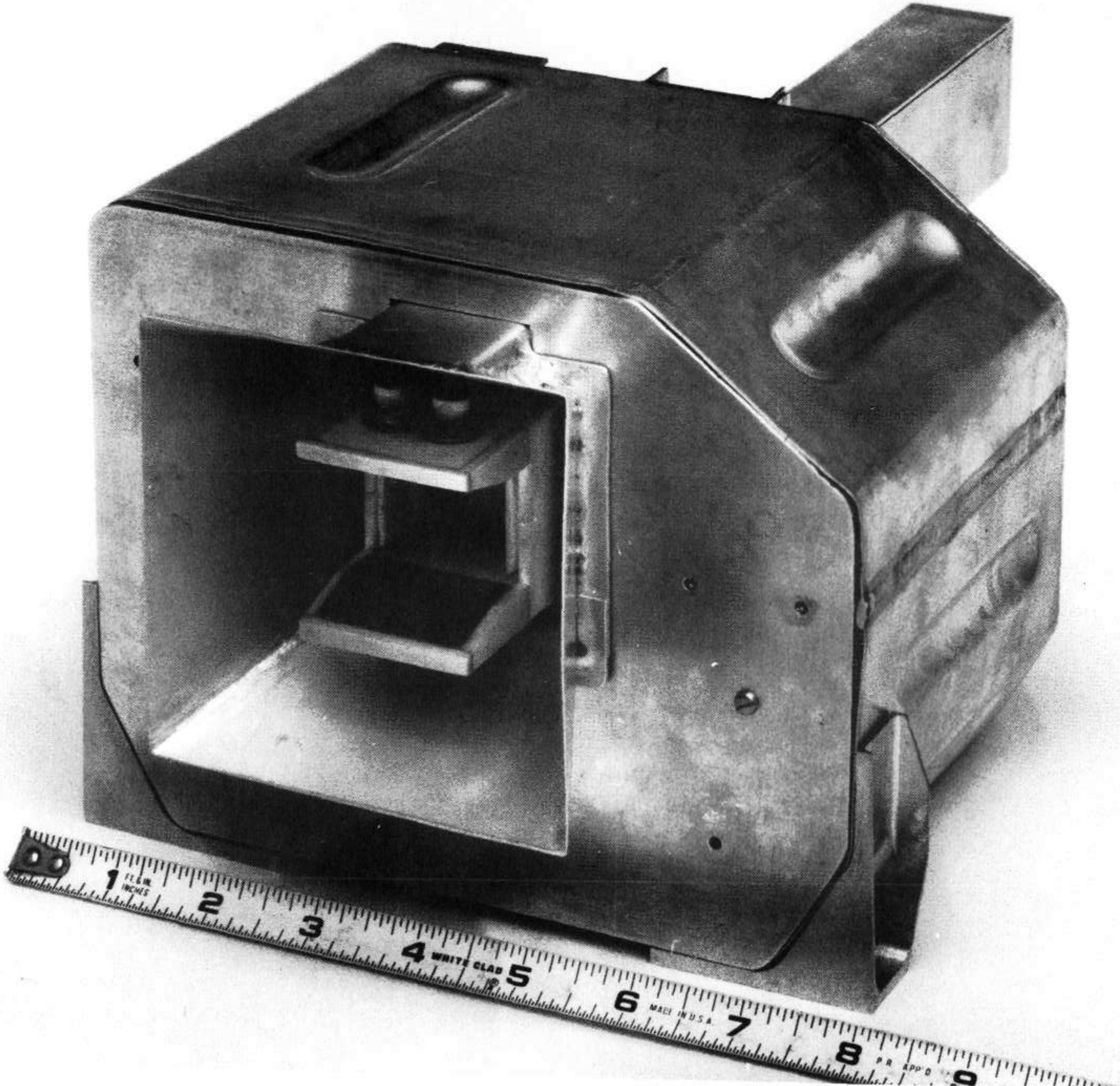

Figure 3. Engineering Model of Flight Prototype Thruster

The converter-charger subassembly is mechanically integrated to the thruster subassembly by bolting it: 1) to the PC145D1015 bulkhead, 2) to the PC145D1013-2 aft mount and by means of two fins on the converter-charger to 3) the PC145D1010 housing assembly. The aft mount cited also represents one of the three system interface mounts to the spacecraft. The aft mount is also bolted to the lower part of the PC145D1040 centerbeam. Electrical interfacing between the two major subassemblies is RFI shielded by the PC145D1043 cover.

The three propulsion system mechanical interfaces to the spacecraft are thus by means of one PC145D1013-2 aft mount cited above and the two PC145D1013-1 forward mounts. These latter forward mounts have been analyzed and redesigned to be located exterior to the thruster package (see drawing PC145D1013-1). The basis for the relocation of the forward mounts is presented in Section 4.2 of this report.

The major thruster subassembly is basically the solid propellant pulsed plasma thruster without the power supply (see Figure 3). The latter being provided by the converter-charger. Section 2 will present a description of design details of the thruster subassembly.

2.0 THRUSTER SUBASSEMBLY DESIGN

By reference to Figure 1, the thruster assembly is comprised of the 1) thruster, 2) propellant subsystem, 3) electrical subsystem, and 3) structural packaging, respectively. These will now be briefly described. Reference will be made to appropriate preliminary drawing numbers identifying parts described.

2.1 THRUSTER

The thruster is represented by the energy storage capacitor (PC145D1090), the provision incorporated to transfer the capacitivety stored energy as efficiently as possible to the electrode nozzle, appropriate electrical insulation and the exhaust cone assembly (PC145D1080). Provisions made to transfer energy efficiently from the capacitors to the electrode nozzles is as follows: Each of the two energy storage capacitors is contained in a thin walled aluminum cylindrical case (PC145D1021). The rear of this case has removable covers (PC145D1022), whereas the front outer periphery of each case is electron beam welded to the negative collector plate (PC145D1023). This subassembly can be seen in the top of Figure 4. The negative terminal (i.e., stud) of each capacitor is passed through the hole of each rear cover (PC145D1022) and secured by a nut. The positive terminal (i.e., stud) of each capacitor passes through a 0.250 in. dia. hole (see lower assembly in Figure 4) in the positive collector plate (PC145D1033). This positive collector plate assembly (PC145D1030) is electrically insulated on both sides. The side facing the capacitor case assembly is covered by teflon sheet. The opposite side of the plate by Shell Epon 828 epoxy. The latter epoxy actually is located between the spokes of the fiberglass face plate (PC145D1050) which may be seen in the lower view of Figure 4. This latter face plate is also described in Section 2.4.

As can be seen from the top assembly in Figure 4, the negative collector plate (PC145D1023) has a square cutout to allow the teflon fuel bar (PC145D1045) to pass into the electrode nozzle. The negative electrode (PC145D1036) is bolted to the negative collector plate (PC145D1023) as can be seen in the top view of Figure 4. The positive electrode (PC145D1032) is bolted to the positive collector plate (PC145D1033) as seen in the lower view of Figure 4. The propellant rod extends forward to the fuel retaining shoulder machined in the positive electrode. Mykroy insulators (PC145D1037) are located to each side of the teflon rod and situated between the electrodes. These two

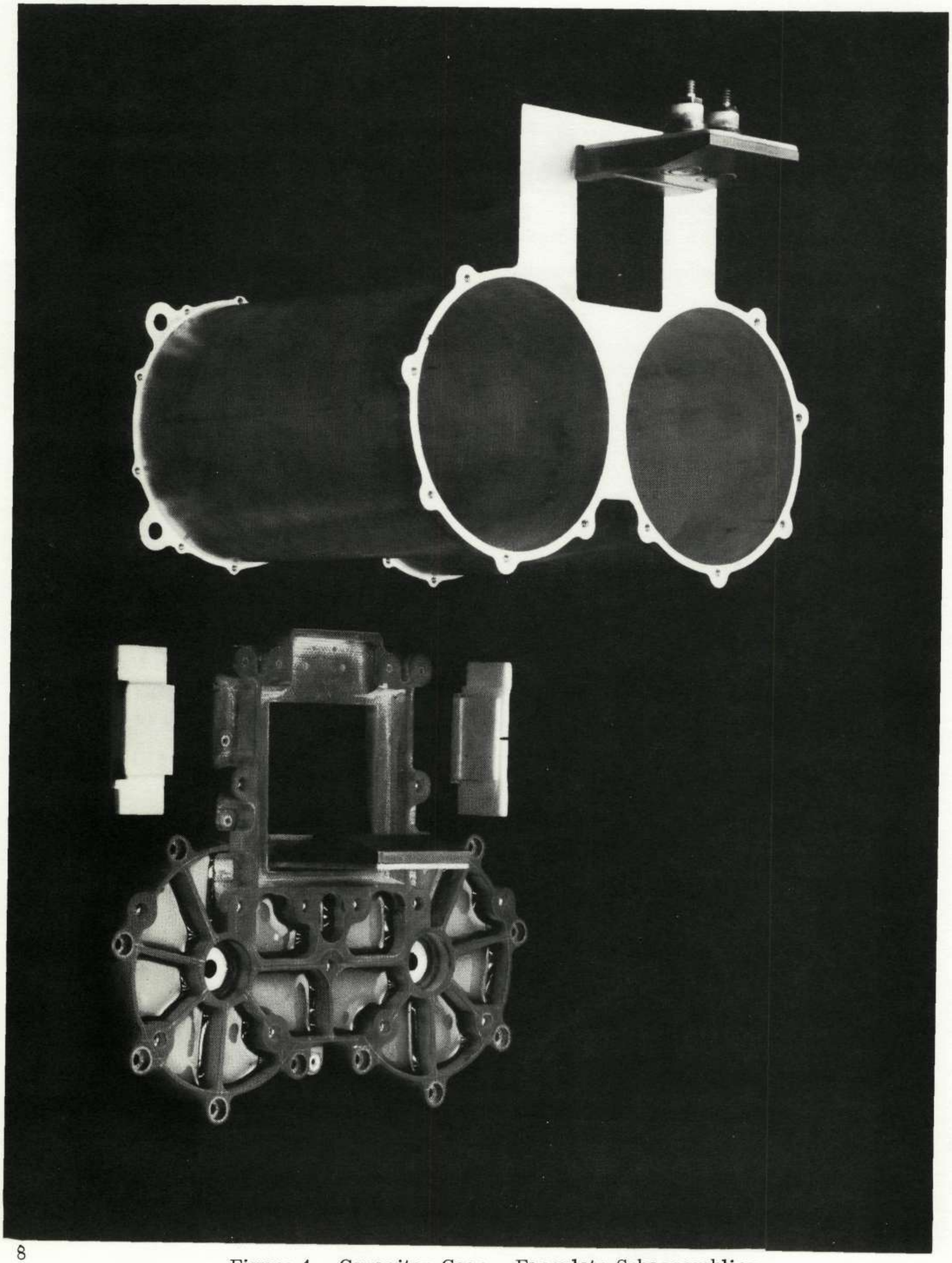

Figure 4. Capacitor Case - Faceplate Subassemblies

Mykroy pieces are also seen in the lower view of Figure 4. With exception of plasma accelerating surfaces, the positive and negative electrode are covered with Mykroy insulators (PC145D1034).

With exception of the electrode area exposed to the plasma of the electrical discharge and the point of contact between the positive terminal of the capacitor and the positive collector plate, the entire subassembly shown in the lower part of Figure 4 is electrically insulated. Assurance of the quality of insulation is had by subjecting this subassembly to the tests specified in Fairchild specification PC145S8019.

The two igniter plugs (PC145D1091) are press fitted into the cathode as may be seen in the top view of Figure 4.

The positive collector plate (PC145D1033) is epoxied to the recessed cutout on the backside of face plate (PC145D1050). The latter has fasteners inserted into it so that the face plate (and thus the positive collector plate) can be screwed to the five front bolt holes (see top assembly in Figure 4) in each capacitor case, thus securing the entire discharge path as another major subassembly. This latter major sub-assembly (less the energy storage capacitors and rear lids) is shown as Figure 5. The Mykroy insulators (PC145D1034) without the PC145D1037 insulator in each electrode are more clearly seen in this latter figure.

The exhaust cone assembly (PC145D1080) is attached by screws to fasteners located in the face plate. The exhaust cone (PC145D1081) is lined with Mykroy (PC145D1084) and epoxied with Shell Epon 828 to all interior surfaces facing the plasma. The exterior of the cone is partially insulated on the outside aluminum surfaces by Shell 828 epoxy.

The thruster as described above is a functionally operative thruster if teflon propellant is provided and electrical leads are connected to charge the capacitor and fire the igniter plugs.

The positive lead charging the capacitor is connected to a tab located on the lower part of the positive collector plate (see PC145D1033). This tab is visible in the lower assembly of Figure 4. It is located at the lowest part of the positive collector plate in the lower outline of the face plate (both Figures 4 and drawing PC145D1033 should be used together to locate this tab.)

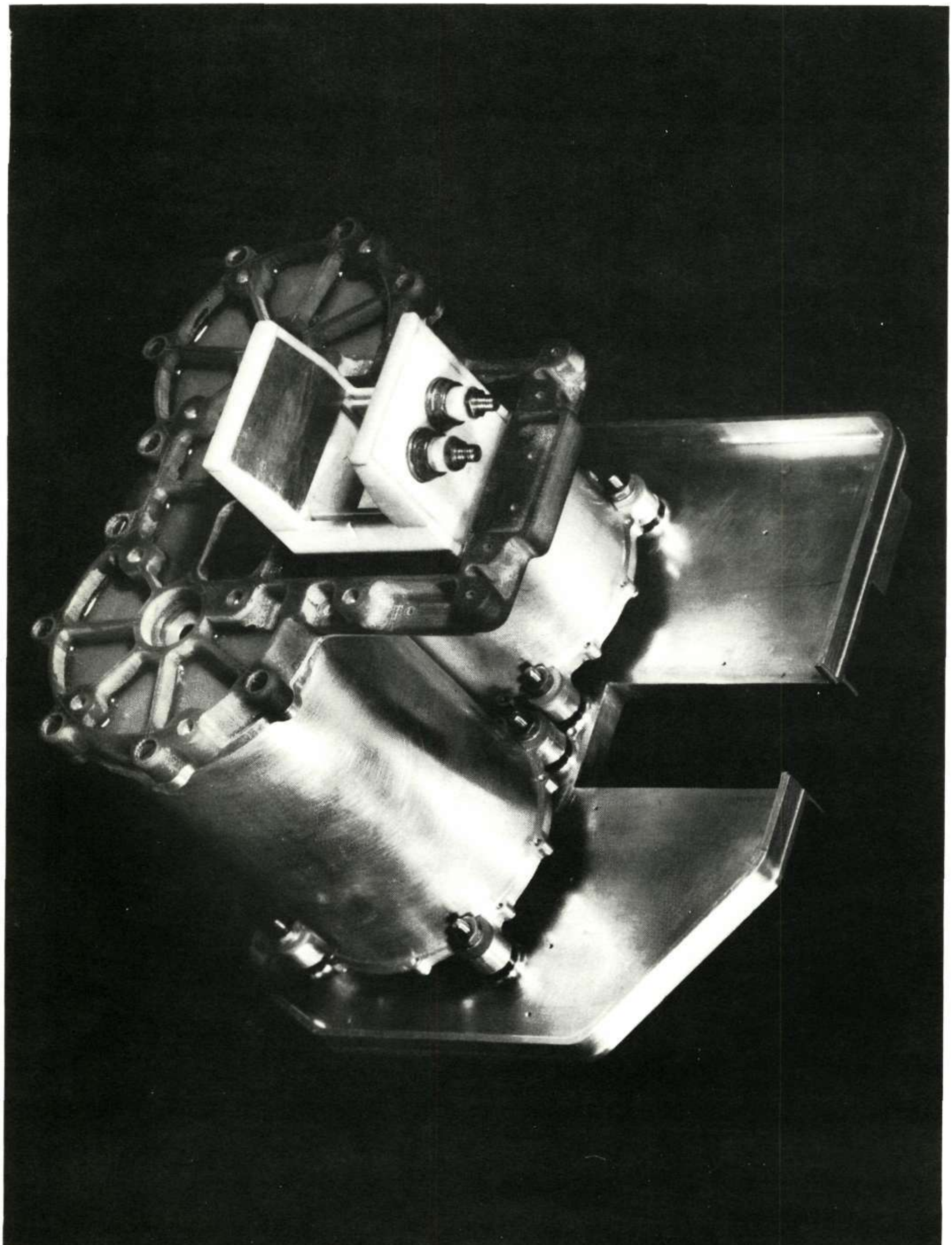

Figure 5. Thruster Discharge Path Major Subassembly

2.2 PROPELLANT SUBSYSTEM

The propellant subassembly (see Figure 6 for subassembly without propellant bar) is comprised of a propellant supporting track (center beam PC145D1040) its upper covers (PC145D1041) and end closure (PC145D1042), and the teflon fuel bar (PC145D1045), the drum (PC145D1047) and Negator spring (PC145D1046). Since the aluminum center beam (PC145D1040) contacts the thruster housing at the bulkhead (PC145D1015), it is at spacecraft ground. It is, therefore, necessary to electrically insulate it from the thruster discharge path. This insulation is achieved by having the forward (nozzle end) part of the centerbeam supported by a fiberglass support assembly (PC145D1051, 1052) which can be seen as the left subassembly in Figure 6. This latter fiberglass assembly is screwed onto the back side of face plate PC145D1050.

The center beam (PC145D1040), i.e., propellant track, is fabricated of two pieces of aluminum and electron beam welded together. Provisions are incorporated to fasten it to the top of the structural housing (PC145D1010), the rear bulkhead (PC145D1015), and the fiberglass support assembly mentioned above (PC145D1051, 1052). It is thus a main structural center beam of the propulsion system.

With the thruster connected to the bulkhead, the center beam is positioned as shown in Figure 7. The end cover (PC145D1042) of the center beam is removable to facilitate reloading or removal of the teflon propellant rod.

The center upper cover (PC1041-2) in the center beam has provisions to allow the thruster electrical subsystem to be secured to it. The Negator spring (PC145D1046) is fastened by the two center screws in the rear of the negative electrode directly to it. The other end of the spring is located on an insulating teflon drum (PC145D1047). The latter is secured to a notched cutout in the rear of the fuel bar by screws. While the negator spring is at the same ground potential of the thruster discharge circuit, it is thus electrically isolated from the thruster housing, i.e., spacecraft ground.

2.3 ELECTRICAL SUBSYSTEM

The thruster electrical subsystem is a separate subassembly straddling the center beam. The location of this subsystem relative to the remaining assemblies described may be seen in Figure 8. (Figure 8 shows the engineering breadboard version of the final circuitry.) It is comprised of three boards: 1) The discharge

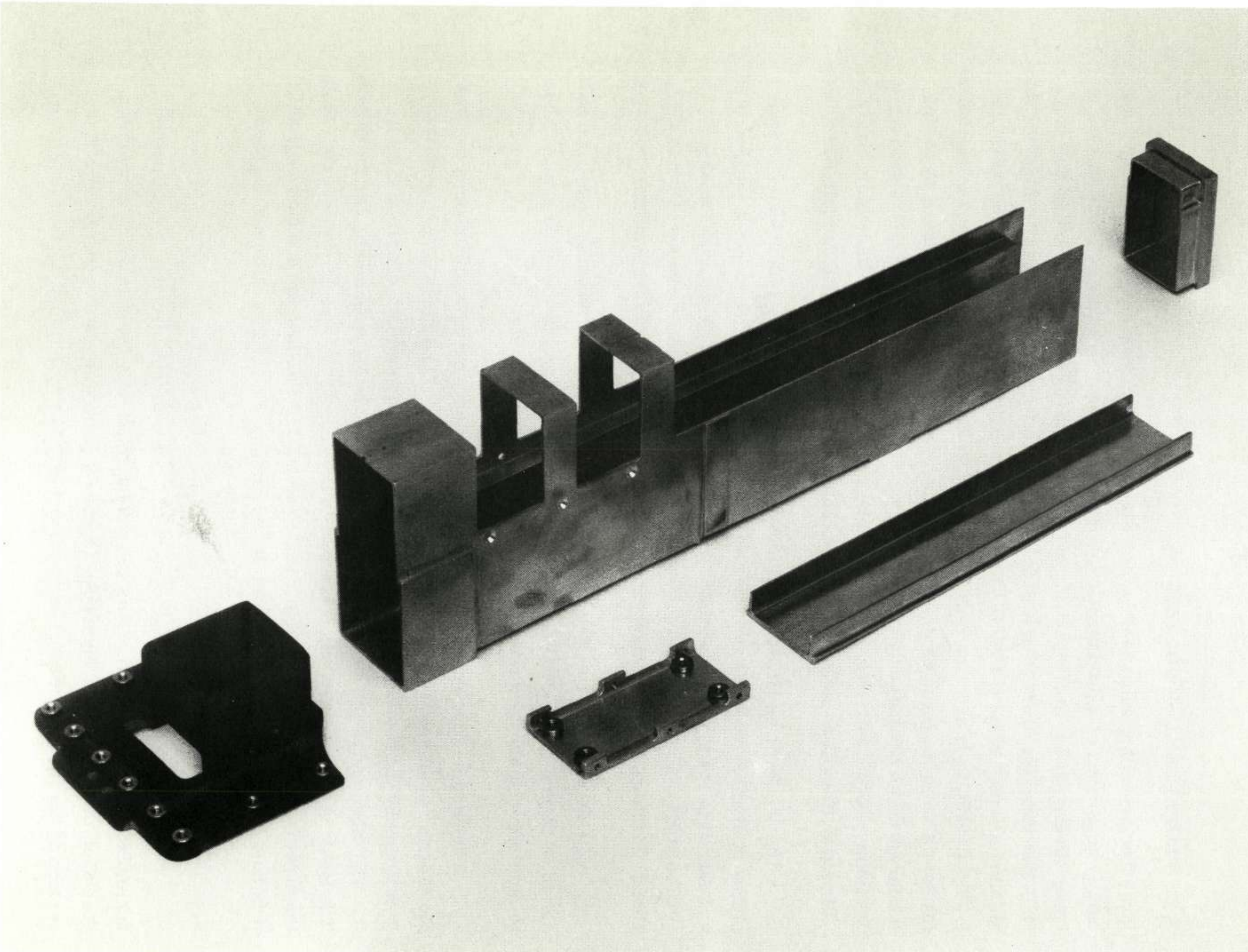

Figure 6. Propellant Subsystem Without Propellant

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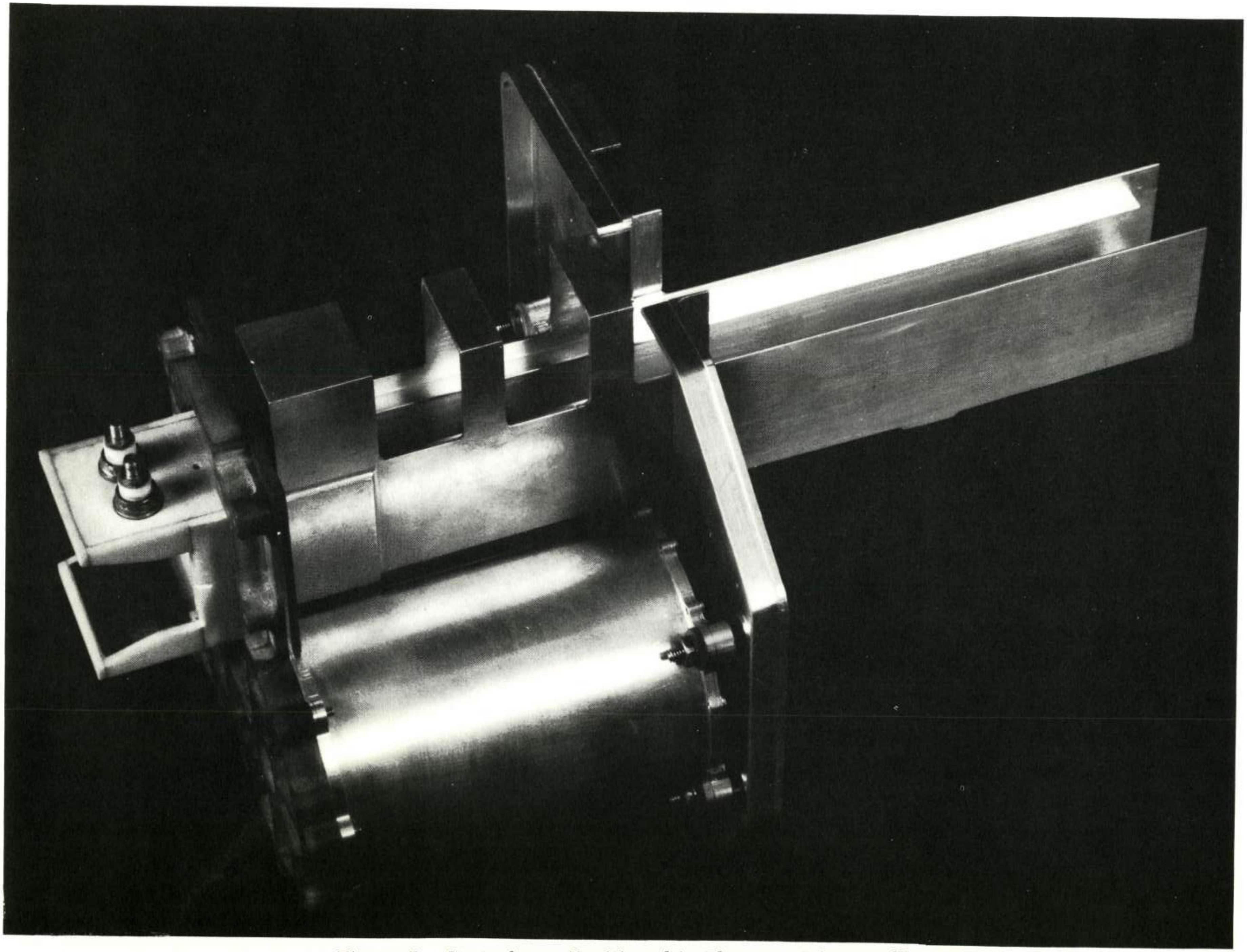


Figure 7. Centerbeam Positioned in Thruster Subassembly

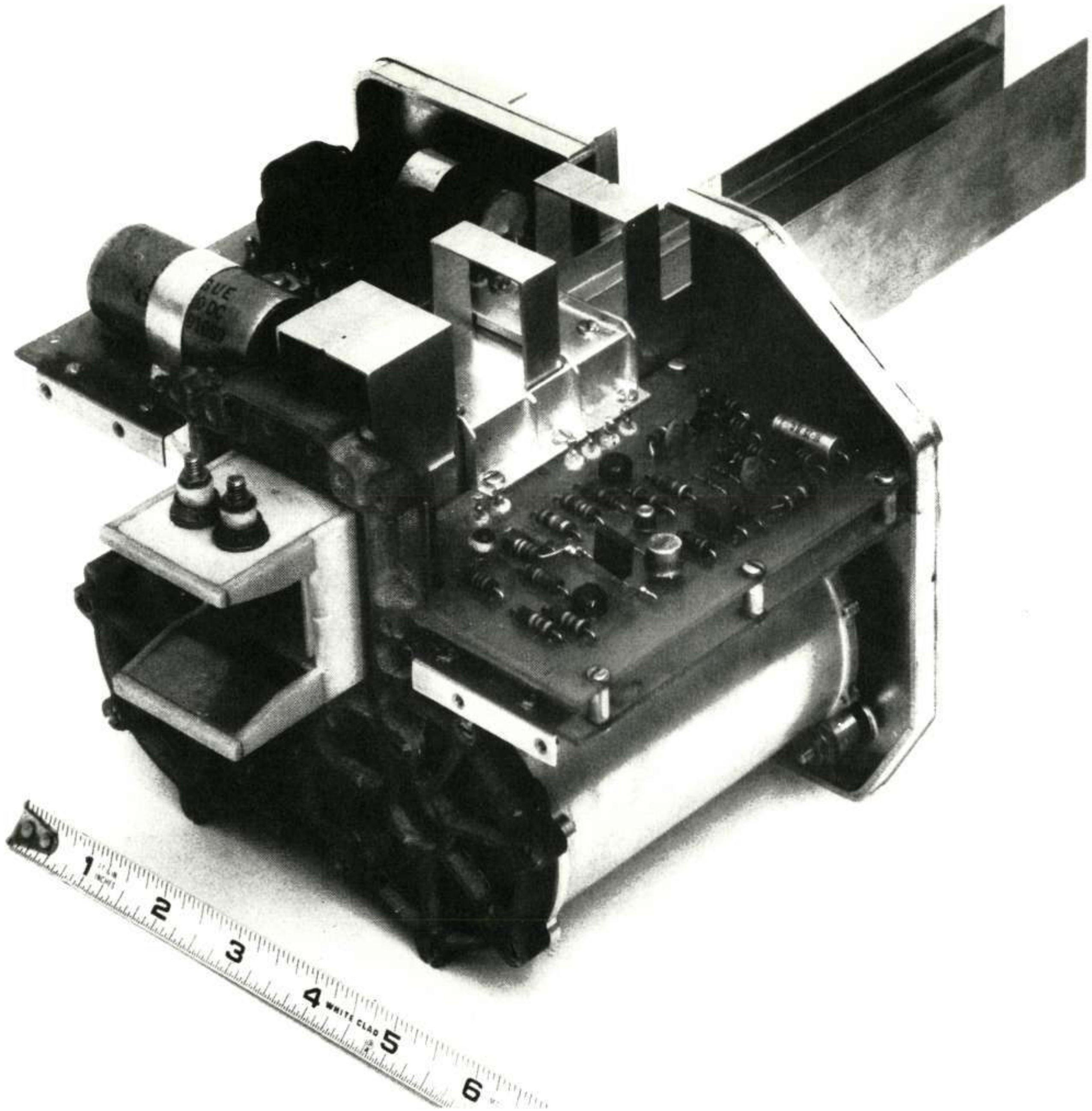


Figure 8. Breadboard Thruster Electronics Positioned in Thruster Subassembly

initiation circuit (PC145D1060) which is the circuit to the left of the center beam in Figure 8; 2) The delay pulse generater (PC145D1071), and 3) The pulse driver (PC145D1075). The latter two are stacked on top of each other separated by spacers (PC145D1074) and are located to the right of the center beam in Figure 8. These three boards are mechanically integrated to each other by an aluminum bridge (PC145D1063) which can also be seen in Figure 8. Upon installation in the thruster, all of these boards are secured by screwing them onto angular clips (PC145D1062) which are also secured to the housing (PC145D1011). Besides being secured to these clips the boards are attached to the bulkhead (PC145D1015) and by the fastening bridge (PC145D1063) to the center upper cover (PC145D1041-2) of the center beam (PC145D1040). The boards are thus not only securely fastened, but they become structurally integrating members of the thruster assembly. The printed circuitry assembly of the delay pulse generator and of the pulse driver are shown by drawings PC145D1071 and PC145D1075, respectively. As mentioned, in the manner installed, the electrical subsystem mechanically assists in distributing mechanical loads in the thruster subsystem. All electrical leads from the power conditioner and the thruster subassembly are passed through the bulkhead without standoffs. The latter wires are covered by an aluminum cover (PC145D1043) thus assuring EMI integrity. Venting of the cavity takes place into the thruster assembly.

2.4 STRUCTURAL PACKAGING

2.4.1 Mechanical

The thruster (see Section 2.1) is fastened to the bulkhead (PC145D1015) which has studs PC145D1017 pressed into it as can be seen in Figure 7. Insulators (PC145D1026) are used to assure an electrically insulated mounting. The bulkhead has a peripheral flange machined onto it so that the housing assembly PC145D1010 can be screwed onto it after it is slipped over the thruster. The cutout in bulkhead (PC145D1015) is sealed with respect to RFI leakage by the assembled center beam (PC145D1040) and the end cover (PC145D1042). These latter items have raised lips incorporated to preclude a direct line of view through the seams in the cutout after assembly. As stated in Reference 1, the housing (PC145D1011) has beads impressed into it (see Figure 3) to stiffen it. Furthermore, two stiffening Z sections (PC145D1012) are fastened to the downstream face (nozzle side) of the housing. The alignment mirror (PC145D1093) is located just below the lower Z section. The forward mounts

(PC145D1013-1) are attached to the two front lower corners of the housing, as can be seen in Figure 3.

The fiberglass face plate (PC145D1050) discussed in Section 2.1 may be considered a structural member. It has insulated PEM nuts not only for fastening the thruster to it, but also insulated PEM nuts for the screws which are screwed into it from the outside front face of the housing. Thus the housing assembly PC145D1010 is also secured to the face plate besides being screwed to the center beam, bulkhead and by clips to the electrical subsystem.

2.4.2 Electrical Isolation

The thruster is rigidly attached to the bulkhead so that the thruster is electrically insulated from the bulkhead yet facilitating thermal conduction. An insulated bushing assembly (PC145D1026) and Beryllium Oxide washers (PC145D1025) are used for this purpose. The attachment of the thruster to the bulkhead is shown in PC145D1014 and Figure 8. (The Beryllium Oxide washers were not available at the time the photograph was taken. Fiberglass washers instead of the Beryllium Oxide washers are used during the phase of the assembly shown in Figure 8.)

A cover (PC145D1043) is used to cover the leads (i.e., electrical) interfacing) connecting the converter-charger to the thruster.

2.5 LIST OF THRUSTER DRAWINGS PRESENTED

Table 1 presents a list of drawings of the components to which the discussion of Section 2.1 through Section 2.4 has referred to. Tentative versions of the drawings which define the final design are presented in Appendix C of this report. The final version of these drawings will freeze the design during Task III - Model Specification.

TABLE 1. THRUSTER DRAWINGS PRESENTED

Drawing Number	Figure Number	Description
PC145D1010	9	Housing Assembly
PC145D1013-1	10	Forward Mount
PC145D1013-2		Aft Mount
PC145D1015	11	Bulkhead Assembly, Enclosure
PC145D1020	12	Capacitor Case Assembly, Case, Cover
PC145D1023	13	Collector Plate, Negative
PC145D1025	14	Standoffs, Thermal
PC145D1026	15	Insulators
PC145D1032	16	Electrode-Positive
PC145D1033	17	Collector Plate-Positive
PC145D1034	18	Mykroy Insulator
PC145D1036	19	Electrode Negative
PC145D1037	20	Insulator, Mykroy Sides
PC145D1040	21	Beam Assembly, Covers, End Closure
PC145D1043	22	Electrical Interface Cover
PC145D1050	23	Forward Faceplate Assembly
PC145D1051	24	Rear Faceplate Assembly
PC145D1052	25	Shield
PC145D1063	26	Bridge
PC145D1064	27	Transformer Base
PC145D1071	28	Delay Pulse Generator Board Assembly
PC145D1072	29	Delay Pulse Generator Drill Drawing
PC145D1073	30	Delay Pulse Generator Artwork
PC145D1075	31	Pulse Driver Assembly
PC145D1076	32	Pulse Driver Drill Drawing
PC145D1077	33	Pulse Driver Artwork
PC145D1080	34	Exhaust Cone Assembly
PC145D1090	35	Capaciter, SCD
PC145D1091	36	Igniter Plug, SCD
PC145D1092	37	Alignment Mirror

3.0 POWER CONDITIONER DESIGN

A detailed description of the operation as well as details of the components selected and a reliability analysis of the components of the Power Conditioner were presented in Reference 1. The Power Conditioner was designed and built for Fairchild Industries by Wilmore Electronics, Inc., to Fairchild Specification PC145S8000 (PC004S8000). The electrical acceptance pre-installation test of the power conditioner will be in accordance with Fairchild Specification PC145S8018 (see Appendix D). This report will only present drawings of the aforementioned design.

3.1 LIST OF POWER CONDITIONER DRAWINGS PRESENTED

Table 2 presents a list of the tentative drawings of the power conditioner. These drawings are presented as Figures in Appendix D of this report.

TABLE 2. POWER CONDITIONER DRAWINGS PRESENTED

Wilmore Electronics Drawing Number	Figure Number	Description
12C0050	38	Subassembly High Voltage Power Conditioner
12C0051	39	Subassembly Delay Trigger Generator
12C0052	40	Subassembly Auxiliary Power Supply
12C0053	41	Subassembly Comparator Regulator
12C0056	42	Subassembly Power Transformer
15C0190	43	Drill Drawing for 15C0181
15C0191	44	Drill Drawing for 15C0182
15C0192	45	Drill Drawing for 15C0185
15C0193	46	Drill Drawing for 15C0188
15C0194	47	Drill Drawing for 15C0189
16C0127	48	Schematic for Subassembly 12C0051
16C0128	49	Schematic for Subassembly 12C0052
16C0129	50	Schematic for Subassembly 12C0050
16C0130	51	Schematic for Subassembly 12C0053
16C0131	52	Converter Schematic
40D0212	53	Enclosure
40C0213	54	Cover

4.0 SUPPLEMENTARY SUPPORTING STUDIES

During the design effort of Task 2 some additional design supporting studies were performed. The results of these studies are presented below.

4.1 SIMULATED HI-G ACCELERATION THRUSTER OPERATION

Section 2.2.1.3 of the Task I report (Reference 1) presented results of a simulated 24.6 g load thruster test performed prior to contract award. The latter test was terminated after 1,200,254 consecutive discharges because of vacuum pumping difficulties. Since the engineering thermal model (Figure 22 of Reference 1) was available during Task 2, it was provided with three SH12K36 Negator springs laminated to provide a 17 lb. force. With an initial teflon propellant weight of 408.2276 grams the simulated initial g loading of the propellant rod against the 0.050 in. high fuel retaining shoulder in the positive electrode is thus 18.8 g's (prior to the test being reported upon the system was checked with the fuel bar weighing 455.1870 grams, i.e., a simulated 17 g's). The engineering thermal thruster model with the high spring force was installed on a thrust balance in a vacuum chamber (see Figure 55) and subsequently operated continuously for 1293 hours.

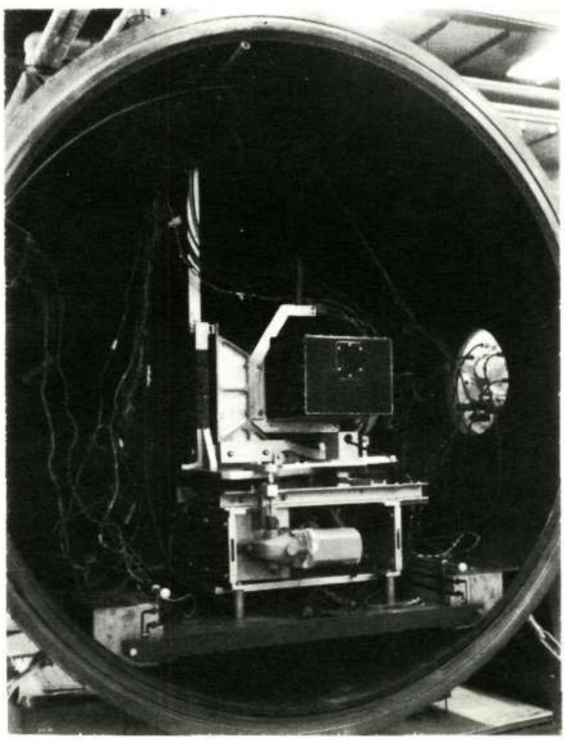


Figure 55. Simulated Hi-g Test on Thrust Balance

Unlike in spaceflight, as propellant is consumed in the laboratory, because of the fixed spring force, the simulated g force increases rather than decreases. The simulated Hi-g test performed is thus a more severe test than will be encountered in flight. Table 3 presents data of the test.

TABLE 3. SIMULATED HI-G TEST (LOG 136-4)

Initial propellant weight	408.2276 gr
Final propellant weight	234.6658 gr
Initial g loading	18.8
Final g loading	33
Test average pulse frequency	1.84 Hz
Total shots of test	8,578,289
Test duration of uninterrupted operation	1293 hours
Test average thrust measured	41.43 micro lb
Test average impulse bit amplitude	22.48 micro lb-sec
Test average specific impulse	505 sec

The test average thruster performance is in accordance with predicted behavior and within program requirements. During the 1293 hours of hi-g operation a total of 51 thrust readings were taken. The data presented above represents the test average of these readings. Of these, 8 readings fell below a 20μ lb-sec impulse bit level. The reason for these 8 readings being below 20μ lb-sec is not known. Since such a behavior has not been observed before with this particular electrode geometry and since the test average results are as predicted and within program requirements, the observed anomaly is only noted at this time.

The test was terminated because of failure of an ES XPJ20002 capacitor. Failure of the capacitor was in accordance with expected life. The history of earlier tests of this family of capacitors is as follows:

SN 13	14,703,251 discharges to failure
SN 14	15,041,970 discharges to failure
SN 15	14,884,282 discharges to failure (High g test)
SN 16	14,545,663 (still ok)

SN 15 and SN 16 used during the present test had discharges accumulated from prior tests. The ESXPJ20003 capacitor to be used in deliverable hardware is a derated version of the ESXPJ20002 that was used during the above test. Furthermore, the flight capacitor will not have the DC life superimposed which the above capacitors were subjected to.

A post test examination of the propellant and electrode assembly was made. No abnormalities were observed which would suggest the system becoming inoperative before the design life expectancy. Figure 56 shows a front view of the thruster after the simulated hi-g test. Figure 57 shows the anode with a slight deposit on it. The cathode is shown in Figure 58. A relatively heavy deposit is noted on the cathode and in particular around the igniter plug area. Such deposits are normally observed on the cathode. The propellant revealed no signs of discoloration or abnormal depolymerization.

The above test results are considered highly encouraging that the final design will meet all performance, life and environmental requirements of the SMS mission.

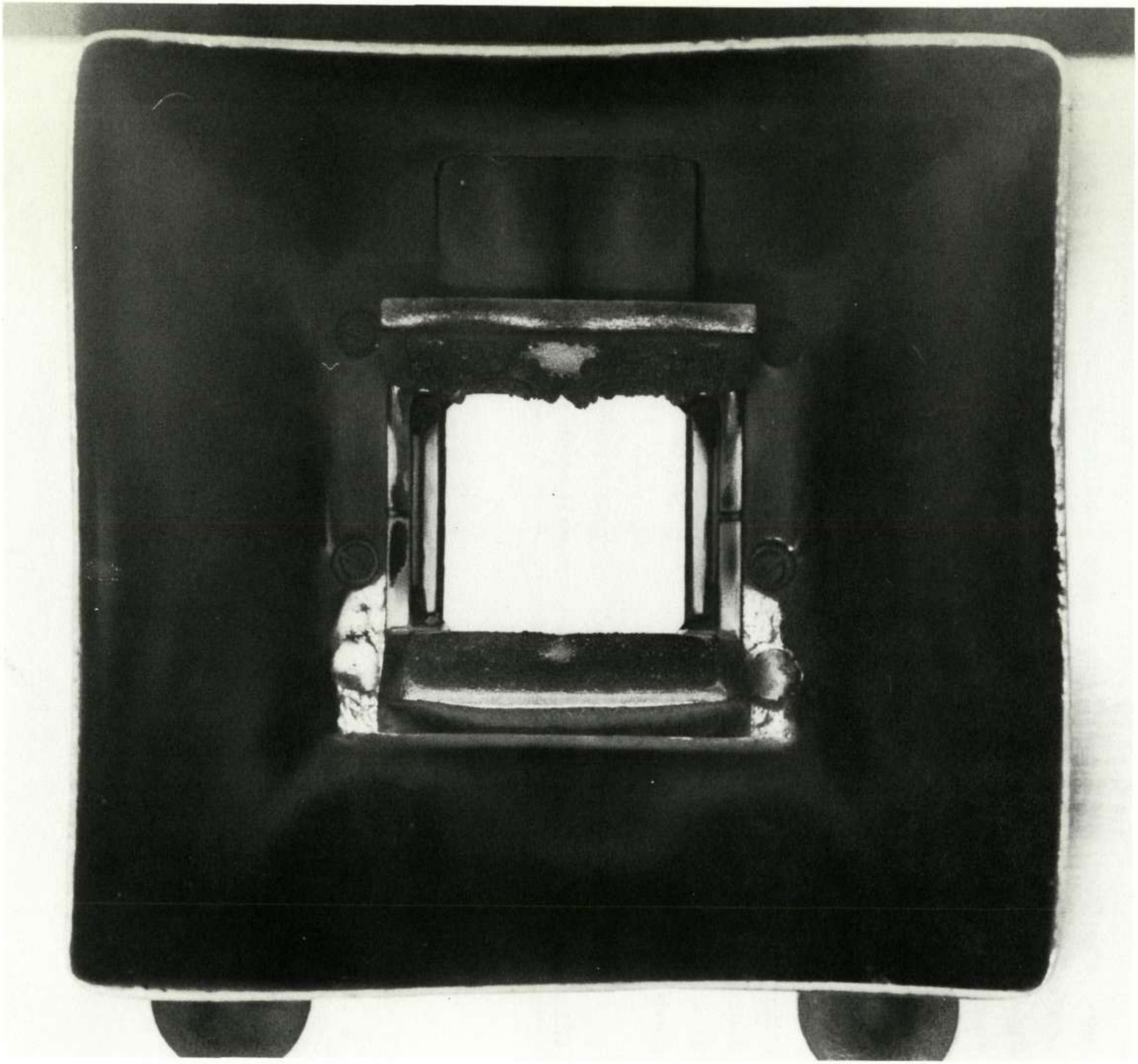


Figure 56. Post Hi-g Test Frontal View

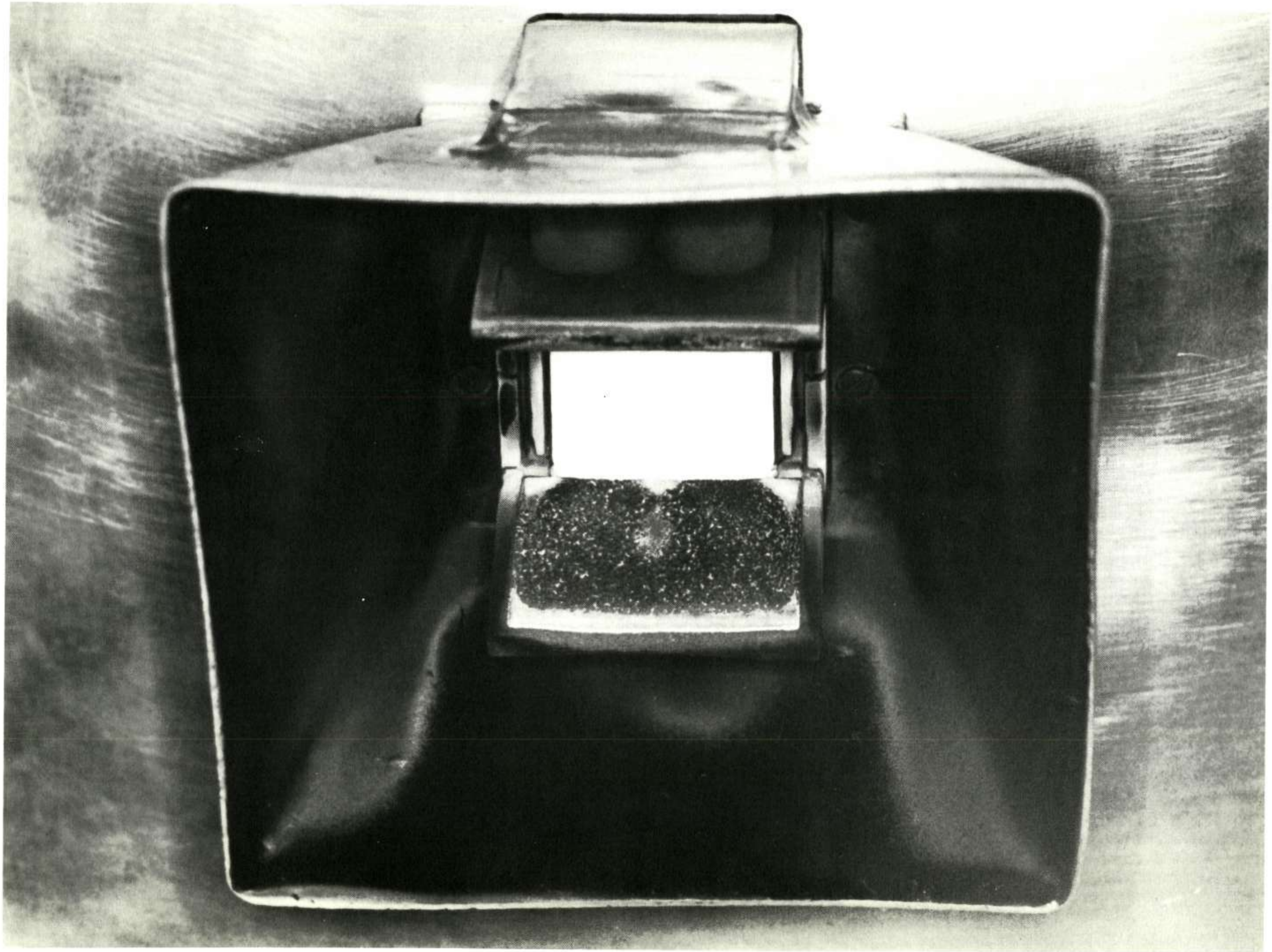


Figure 57. Anode of Hi-g Test

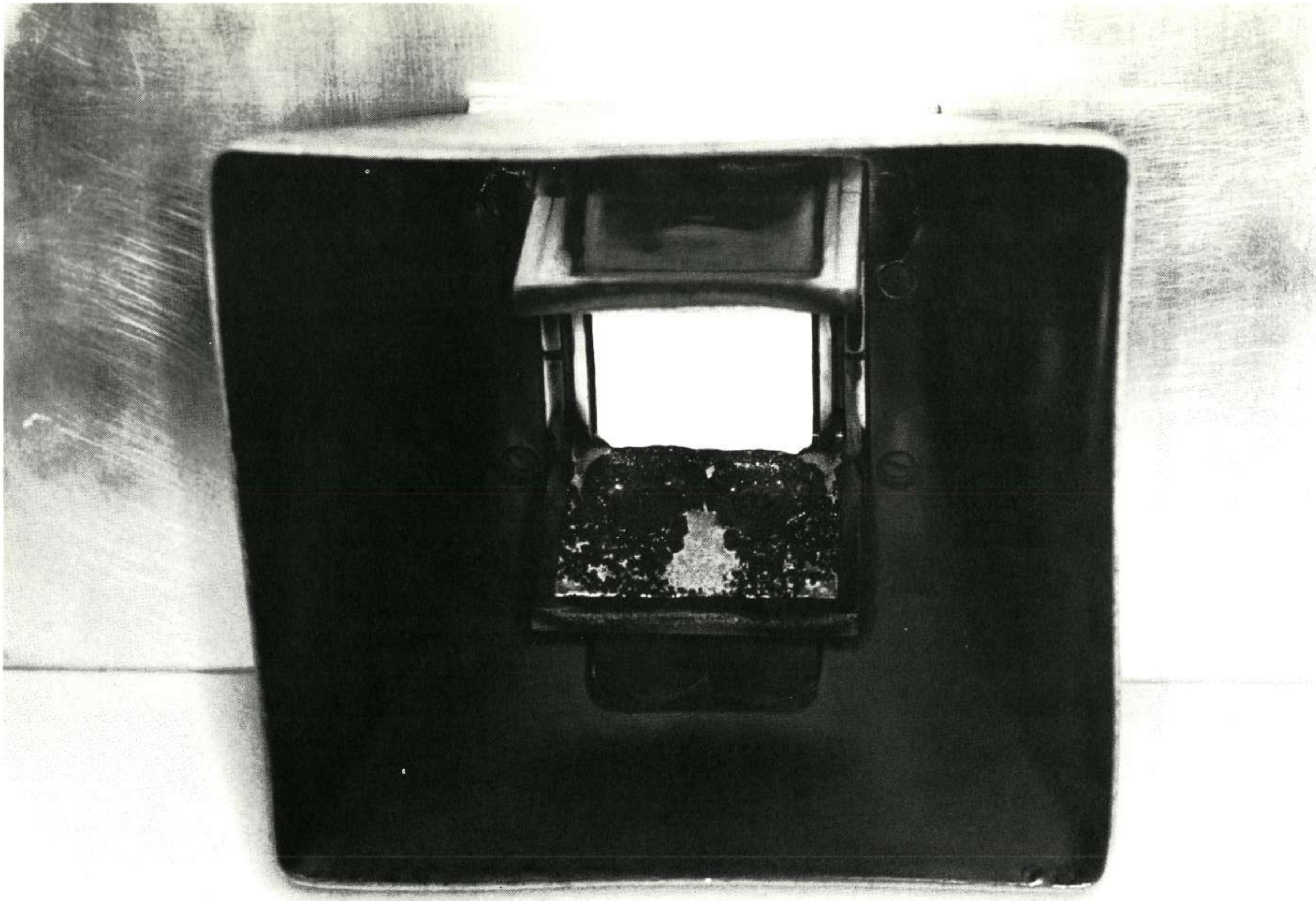


Figure 58. Cathode of Hi-g Test

reacted at the support. If the clip is .100 inch thick and .750 inches wide, this moment causes a bending stress of 95000 psi. Since the bending yield for 6061 T6 aluminum is 35000 psi this clip should be designed for higher stiffness, i.e., thicker section or channel shape. However, if the tie-down points are moved further apart so that they are directly under the housing skin, the problem of the bending moment is eliminated while at the same time provision can be made for external access to the mounting fasteners. Thus, it is recommended that the mounting holes be placed about 7.3 inches on center and the housing skin be tied to a mounting bracket with five rivets on the side and five rivets on the bottom. These .093 diameter rivets will cause a maximum bearing stress of 11300 psi which is well below the bearing yield of 50000 psi. The maximum shear stress is 3100 psi. A request for the change was submitted to Mr. Williams of GSFC for approval. The proposed increase was approved by NASA TD112 and was subsequently incorporated in the design (see Figure 3).

4.3 FURTHER STRUCTURAL CONSIDERATIONS OF VIBRATION ENVIRONMENT

In order to ascertain whether the microthruster will sustain the qualification vibration tests without failure, it is important to know the resonant frequencies and modes associated with it. For this purpose the thruster was considered as a simply supported beam with six lumped masses. The flexibility of the microthruster in a direction perpendicular to the mounting surface (the direction in which the microthruster is most flexible) was represented by an EI distribution along the beam. A set of influence coefficients was derived and used in a matrix iterative procedure to obtain the modes and frequencies.

The frequency of the first mode 3370 Hz is far above the 2000 Hz limit of the vibration test. Thus, although beam representation of the microthruster is a very simplified one in which effects of rotary inertia and motion in othogonal directions are neglected, the high frequency of the first mode indicates that in the shake test no flexible mode involving motion of the whole assembly will have a frequency below 2000 Hz. Under this condition there will be no amplification in response to the input g levels. However, there may be localized resonances of lower frequency involving significant masses which are not uncovered by the beam analysis. Accordingly, several simplified calculations have been made to obtain an estimate of these frequencies. The results of these analyses indicate that for any resonance in which there is motion of a component with significant mass the frequency should exceed 100 Hz. Some sample frequency calculations are shown below. The sinusoidal test schedule calls for a maximum level of 5 g for frequencies above 100 Hz (i.e., from 200 to 2000 Hz). If the critical damping ratio for any resonance is assumed to be .03 or greater and if it is understood that at any resonant frequency only part of the total microthruster mass will be moving, the load at the support points should never exceed that which would exist for the equivalent of 50 g at the overall center of gravity. For this condition assuming inertia loading in the vehicle thrust direction the most highly stressed point will be the bottom of the rear support bracket. This stress, 21646 psi, in bending is well below the yield for 6061TG which is 35000 psi.

During the random vibration test the input level corresponds to 9.2 g rms. To this there is some added effect due to peaks clipped at 3 times specified levels and due to amplification of local resonances in the 20-2000 Hz range. Even with these added effects the overall level at the support should be well below 50 g.

Consequently the microthruster is expected to survive the random and sinusoidal vibration tests without failure.

4.3.1 Fore and Aft Motion of Capacitor

For simplicity the capacitor is assumed to be restrained only by the 7 spokes of the fiberglass faceplate (PC145D1050). The spokes are taken as cantilevered with a concentrated load representing 1/7 the mass of the capacitor at one end.

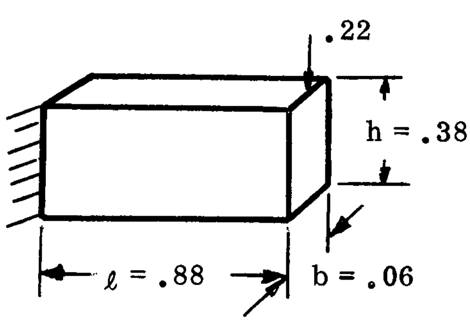


Figure 59. Idealized Spoke of Faceplate

$$f = \frac{1}{2\pi}\sqrt{\frac{k}{m}} = \frac{1}{2\pi}\sqrt{\frac{3EI}{m\ell^3}} = \frac{1}{2\pi}\sqrt{\frac{3(2.5)\,10^6\,(.06)\,(.38)^3\,386.}{.22\,(12)\,(.88)^3}} - 366 \text{ Hz}$$

The calculated frequency f = 366 Hz will tend to be reduced because the ends of the spokes are not quite cantilevered. On the other hand, the frequency f will tend to be raised due to the added support of the stiffening "zee" sections (PC145D1012) and the supporting structure at the aft end of the capacitor. In any case it should be reasonable to assume that the actual frequency will be above 100 Hz.

4.3.2 Rear Main Thruster Mount

The base of the rear main mount is a flat surface 1.1 by .63 inches and .1 inch thick supported on three sides. A 1 g vertical load on the microthruster would result in a load of approximately 3.8 pounds at the rear support. The following simplified calculations use case No. 50 in Reference 2.

The maximum deflection for a uniformly distributed load is:

$$y = \frac{\alpha\,\omega a^4}{Et^3}$$

where: α = .09 for a long side to short side ratio of 1.8

If we use a factor of 1/1.6 as the approximate ratio for deflection under uniform load to deflection under the actual concentrated load, the deflection is:

$$y = \frac{1.6\,(.09)\,5.59\,(1.1)^4}{(10^7)\,(.1)^3} = 1.1785\ 10^{-4}$$

The approximate frequency corresponding to this deflection is:

$$f \approx 314\sqrt{\frac{10^4}{1.1785}} = 289 \text{ Hz}$$

This is a very approximate frequency calculation. However, it is reasonable to conclude that the actual frequency will be greater than 100 Hz. According to Ruark the maximum stress associated with the above loading is:

$$\frac{\beta\,\omega\,a^2}{t^2}$$

If we assume a 50 g loading and increase the stress by the 1.6 factor and use a value of .4 for β, the maximum stress is:

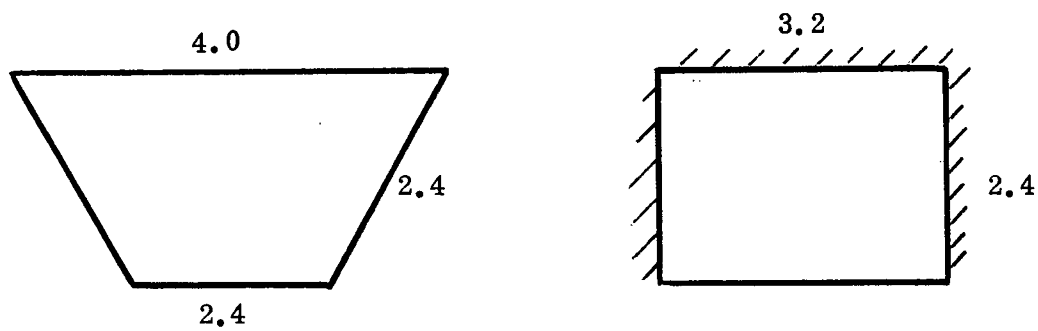
$$\frac{1.6\,(.4)\,50\,(5.59)\,(1.1)^2}{(.1)^2} = 21646 \text{ psi}$$

This is well below the 6061-T6 yield of 35000 psi.

4.3.3 Exhaust Cone

The thruster exhaust cone (PC145D1080) is a small part of the total mass so that any resonances which are excited on the cone will have negligible effect on the overall loading at the main thruster supports. However, it is necessary to ascertain whether local stresses will cause failure of the cone itself.

Consider one side of the exhaust cone. It has the approximate shape shown in Figure 60a.



a) Approximate Cone Surface Shape

b) Idealized Cone Shape

Figure 60. Cone Surface Configuration

We can approximate this shape as a rectangular flat plate supported on three sides as shown in Figure 60b with a .030 inch thick layer of Mykroy on a .030-inch thick aluminum substrate.

Assume that the Mykroy contributes mass but not stiffness, then the maximum deflection is:

$$y = \frac{\alpha \omega a^4}{Et^3}$$

where:

α = .12

E = 10^7

t = .03

a = 3.2

ω = .006 lbs/in.^{2}

$$y = \frac{.12\,(.006)\,(3.2)^4}{10^7\,(.03)^3} = .0002796 \text{ inches}$$

and the frequency is thus:

$$f = 3.140\sqrt{\frac{1}{279.6}} = 188 \text{ Hz}$$

The latter frequency is also above 100 Hz.

4.4 WEIGHT CONSIDERATIONS

During Task II the design has advanced to the point where a more accurate revised systems weight estimate can be made. Based upon presently available data the total propulsion system weight (including propellant) will be about 4142 grams (9.13 lb). This weight is made up of 3292 grams (7.26 lb) for the thruster subassembly and 850 grams (1.87 lb) for the power conditioner subassembly. Table 4 presents a further breakdown of the thruster weight by major and minor assemblies as best as can be determined at this time.

Every attempt has been made in the design of Task 2 to keep the weight of every item at an absolute minimum. The extra design and fabrication effort required to achieve minimum weight can be noted for example by an examination of the items presented in Figure 4.

TABLE 4. BREAKDOWN OF REVISED THRUSTER WEIGHT

Major Item	Minor Item		Item Weight (grams)	Total Weight (grams)
a) Structural				
	Bulkhead with studs		108.4	
	Housing		142	
	Bulkhead inserts		6.5	
	Forward mounts		30	
	Aft mount		19.8	
	Z		55	
	Electrical cover		35	
	Insulated mounts		9.4	
		Subtotal	406.1	
b) Fuel Subassembly				
	Beam		126.5	
	End cover		11	
	Top cover		21.5	
	Fiberglass box		30.0	
	Usable fuel		400	
	Spring assembly		28	
		Subtotal	617	
c) Thruster Electronics				
	Entire package		441	
d) Discharge Subassembly				
	Faceplate with positive collector plate, electrode		255	
	Negative electrode subassembly		78	
	Can subassembly		94.5	
	Can covers		33.2	
	Capacitor		1197	
		Subtotal	1657.7	
e) Miscellaneous				
	Cone with Mykroy		110	
	Paint		50	
	Mirror		4	
	Screws, etc.		6.2	
		Subtotal	170.2	
f) Power Conditioner				
	Complete		850	
Estimated Total System Weight				4142

5.0 PROGRAM FOR NEXT REPORTING PERIOD

The next reporting period will provide the Task B "Model Specification". The design described in the present Task 2 report will be frozen upon completion of Task 3 effort. The Task 4 effort "Final Fabrication and Test" will be initiated prior to completion of the Task 3 effort.

6.0 CONCLUSIONS

The results presented herein have shown that inherent functional simplicity underlying the flight proven LES-6 design can be maintained in the SMS system design even with minimum weight constraints imposed. Furthermore, a 1293 hour uninterrupted vacuum test with the engineering thermal model simulating an 18.8 to 33 g environment of the propellant, its fuel system and electrode assembly revealed that program thruster performance requirements could be met. This latter g environment is a more severe environment than will be ever encountered in the SMS spacecraft. Best available data at this point indicates that the completed propulsion system weight including propellant will be about 9.13 lbs.

7.0 REFERENCE MATERIAL

7.1 REFERENCES

1. "Task 1 - Design Analysis Report, Pulsed Plasma Solid Propellant Microthruster for the Synchronous Meteorological Satellite," Edited by W.J. Guman, Interim Report on Contract NAS5-11494, PCD-71-7, PC145R8000, FRD 4070, Fairchild Industries, Fairchild Republic Division, Farmingdale, New York.

2. Roark, R.J., "Formulas for Stress and Strain, McGraw Hill Book Co., N.Y. 1938.

7.2 APPENDICES

APPENDIX A. LIST OF APPLICABLE DOCUMENTS

Fairchild Document	Item	Type of Specification
PC004S8000 PC145S8000	Power Conditioner	Product
PC145S8001	Energy Storage Capacitor	Product
PC145S8002	Capacitor B161Y203-302K	Screening
PC145S8003	Capacitor 118P10591032	Screening
PC145S8004	SCR C137PB1200	Screening
PC145S8005	Negator Spring	Product
PC145S8006	Diode UT2080	Screening
PC145S8007	Pulse Transformer 8TE5904E	Product
PC145S8008	Surface Igniter Plug 10-380729-1 Change A-4	Product
PC145S8009	Negator Dry Film Lubricant	Material & Process
PC145S8010	Thermistor RTH06BS472J	Screening
PC145S8011	Pulse Transformer	Screening
PC145S8012	Surface Igniter Plug	Pre-Instal. Test
PC145S8013	Thruster Capacitor	Pre-Instal. Test
PC145S8014	Cone High Pot. Test	Pre-Instal. Test
PC145S8015	Pulse Driver Circuit Board	Pre-Instal. Test
PC145S8016	Delay Trigger & Flip Flop	Pre-Instal. Test
PC145S8017	Discharge Initiating Circuit	Pre-Instal. Test
PC145S8018	Power Conditioner	Pre-Instal. Test
PC145S8019	Front Assembly Hi-Pot Test	Pre-Instal. Test
PC145S8020	Qualification Sinusoidal & Random Vibration	Qualification Test

APPENDIX B. SAMPLE SPECIFICATION

August 10, 1971
PC004S8000

FAIRCHILD INDUSTRIES, INC.
Fairchild Republic Division
Power Conversion Department

Product Specification for:

SMS POWER CONDITIONER

Prepared by: Robert Gelbman
R. Gelbman PCD

Approved by: William J. Guman
W.J. Guman, Program Manager

POWER CONDITIONER SPECIFICATION

1. SCOPE

1.1 This specification describes an energy conversion system specifically tailored for the SMS Satellite mission. The energy conversion system is hereafter referred to as the Power Conditioner.

2. APPLICABLE DOCUMENTS

a. Requirements for Soldered Electrical Connections, NHB 5300.4 (3a) May, 1968
b. Inspection System Provisions for Suppliers of Space Materials, Parts, Components, and Services; NPC 200-3, April 1962
c. Printed Wiring Boards, S-300-P-1A October 1966
d. General Environmental Test Specification for Spacecraft and Components GSFC S-320-G-1, October 1969
e. Connectors Subminiature, Electrical and Coaxial Contact, for Space Flight Use; GSFC S-311-P-10, April 1, 1970
f. GSFC Preferred Parts List, GSFC PPL-11, July 1970
g. Contractor Malfunction Reporting, GSFC S-312-P-1, March 1970
h. Requirements for Photographic Documentation S-253-P-4 (Still Photography)

3. REQUIREMENTS

3.1 General Requirements

3.1.1 Main Capacitor Load

The power conditioner shall perform the function of charging a capacitor load to a predetermined high voltage without warm-up time within the scope of the specifications enumerated elsewhere in this document.

3.1.2 Auxiliary Capacitor Load

The power conditioner shall perform the function of charging an additional capacitor load to a predetermined intermediate voltage without warm-up time within the scope of the specifications enumerated elsewhere in this document.

3.1.3 Telemetry and Hardware Monitors

The power conditioner shall also perform the function of supplying telemetry signals and hardware monitors as enumerated elsewhere in this document.

3.1.4 There shall be no function adjustment screws allowed on the power conditioner.

3.2 INPUTS

3.2.1 Primary Power

Primary power will be supplied from a regulated solar array bus having an output voltage within the range of 29.4 volts ± 0.2 volts DC. The output impedance of this source is 0.5Ω maximum, 0.2 Ω typical from DC to 50 KHz. The power conditioner will function normally with this input source of power. Maximum Input Power design goal: 20 watts @ 110 RPM (1.833 charge cycles/sec).

3.2.2 Housekeeping

3.2.2.1 The 29.4 volt solar array bus voltage will be continuously applied to the power conditioner. A separate 28 volt ±2.0 volt enable signal from a 200 ohm source impedance will be applied to energize the power conditioner. The power conditioner will be on when this signal is 28 volts ±2 volts D.C. and will be off when the signal is 0 volts ±1.2 volts D.C. from a 5000 Ω source impedance. Current drain from this source shall be 0.5 ma maximum.

3.2.2.2 Fire Command Signal

The Fire Command Signal shall be defined as follows:

a. Logic One (Command Level) +5.0 volts ± 0.5 volts DC
b. Logic Zero (Ground Level) 0.0 volts ± 0.5 volts DC
c. Duration: 50 milliseconds ± 5 milliseconds
d. Repetition Rate: 0.5454 second to 1.2 second (.833 pulse/sec to 1.833 pulses/sec)
e. Rise and Fall times - Greater than 2 microseconds and less than 10 microseconds

The impedance on the Fire Command Line shall be 10 KΩ minimum. The power conditioner shall be capable of continuously receiving Fire Command Signals while power source is turned off. Upon application of power the power conditioner shall begin normal operation. Turning the power source on and off shall be considered a normal operating mode.

3.3 OUTPUTS

3.3.1 The power conditioner shall be capable of charging two (2) 4.0μ fd ±5% capacitors, connected in parallel, to 1450 volts ±1% in 500 milliseconds ±40 milliseconds over a temperature range -20°C to +60°C in air or in a vacuum with a base plate temperature of -20°C to 60°C. The capacitor charge time shall not in any case exceed 540 milliseconds with 29.4 volts ±0.2 volts input. The change in capacitance with temperature shall be about +1% at 140°F and -4% at -40°F.

3.3.2 The power conditioner shall also supply an output capable of charging two (2) 1.0μ fd ± 5% capacitors connected in parallel to 620 volts ± 20 volts DC in the charge time specified herein (i.e., 3.3.1.).

3.3.3 Pulse Rate Sensing

The power conditioner shall be capable of sensing the Fire Command pulse rate such that, at the maximum pulse rate (110 ppm), the recharging of the energy storage capacitor begins almost immediately after each thruster firing, but at lower pulse rates ($50 \leq$ pulse rate ≤ 110) the initiation of recharging will be delayed before the next fire pulse.

The duration of this delay is pulse frequency dependent. (See Figure 1.) The hold off time, is defined as the time interval after full output voltage is attained up to the time of thruster firing. Hold off time shall be greater than 5 milliseconds and less than 50 milliseconds. The pulse rate adjustment circuit shall be capable of adjusting the hold off time such that it does not exceed 55 milliseconds within 30 seconds after the power conditioner has been turned on or after the satellite has changed its spin rate.

3.3.4 Duty Cycle

The power conditioner must be capable of operation at a maximum rate of 110 cycles per minute. When the load capacitors are charged, the power conditioner high voltage outputs must be maintained at 1450 ± 1% and 620 ± 20V respectively for any worst case combinations of input voltage and environment until a firing command pulse causes thruster firing. If the 620 volt output should be discharged while the 1450 volt is not, both the 620 V and 1450V shall be restored in the next charge cycle.

3.3.5 The power conditioner shall supply + 12 VDC ± 0.5V at 25 ma and 29.4 volts to the control logic when the enable signal energizes the power conditioner.

3.3.6 The power conditioner shall also supply the fire command signal to the control logic. The power conditioner shall present 100 K Ω minimum impedance to the fire command pulse.

3.3.7 Telemetry Outputs

Four (4) telemetry channels shall be provided as follows:

a. Enable signal: 0 to + 32 volts
b. Main capacitor voltage: 0 to 1.2 times nominal
c. Discharge initiation capacitor voltage: 0 to 1.2 times nominal
d. Mean internal thruster temperature: -50°F to + 150°F

The telemetry output signals shall be between zero and +5 volts. Each channel shall contain limiting circuitry so that the output signal can go to + 5.5 volts maximum and -0.7 volts minimum. The telemetry maximum output impedance of any channel shall be 1000 ohms or less. The cutoff (3 db down) frequency for the voltage measurements shall be about 150 Hz. Sufficient isolation shall be provided in the telemetry circuits such that shorting an output to ground or to any other telemetry output shall not damage the telemetry circuitry or affect in any manner the operation of the microthruster. EMI filters are required on these outputs.

3.3.8 Hardwire Monitors

A system of hardwire monitors is desired to supply detailed information during qualification tests and other ground tests. These shall consist of individual monitor leads connected directly to key points in the circuitry. All of these monitors shall be brought out to a single connector mounted on the housing. (See Figure 2.) As a minimum the following conditions shall be monitored:

a. Thruster supply voltage
b. Energy storage capacitor voltages
c. Charger enable signal
d. Firing command input to the discharge initiation circuit.

The contractor shall review his design and make recommendations as to what additional functions should be monitored. EMI filters are not required on these outputs.

3.4 PROTECTION

3.4.1 Short Circuit Protection

The power conditioner shall not sustain damage when operating into a short circuit in any of the load capacitors for sustained periods under all operating conditions specified herein.

3.4.2 Open Circuit Protection

The power conditioner shall be protected from operation without a capacitor load by an externally mounted capacitor which is to be removed before the power conditioner is hard wired to the thruster.

3.4.3 Bleeders

In the event that any or all of the output loads of the power conditioner fail(s) to be discharged following power conditioner de-energizing, the 1450 load voltage will discharge through bleeders and/or leakages to less than 73 volts in 30 minutes or less.

3.5 ENVIRONMENTAL CONDITIONS

The power conditioner shall be designed to meet the following requirements

3.5.1 Shock

Three 850-g, 0.2 millisecond impacts along each of three orthogonal axes one of which is parallel to the spacecraft thrust axis.

3.5.2 Humidity

The power conditioner shall be installed in a temperature and humidity chamber where the atmospheric condition in the immediate vicinity of the power conditioner is as follows and in which the air is constantly circulated by a fan:

a. Temperature: 86°F ± 4°F

b. Relative Humidity: 90% ± 3%

After stabilization, the power conditioner shall be exposed to the foregoing conditions for 24 hours. Subsequently the power conditioner shall be operated and its performance checked.

3.5.3 Vibration:

The power conditioner shall be attached to the vibration generator via a rigid fixture. Attachment of the power conditioner to the fixture shall simulate the actual attachment of the power conditioner to a spacecraft structure. Vibrations shall be applied in each of three orthogonal directions, one direction being parallel to the spacecraft thrust axis.

3.5.4 Sinusoidal - Swept Frequency

This portion of the test shall be conducted by sweeping the applied frequency once through each range specified in the schedule. The rate of change of frequency shall be two octaves per minute.

Sinusoidal Vibration Schedule

FREQUENCY (Hz	LEVEL (g, 0 to peak)	AXIS
5 - 10	0.5" DA (double amplitude)	Lateral X-X, Y-Y (Launch vehicle lateral)
10 - 20	14.0	
20 - 100	4.0	
100 - 200	2.0	
200 - 2000	5.0	
5 - 11	0.5" DA (double amplitude)	Perpendicular to mounting plane (Launch vehicle thrust)
11 - 17	3.0	
17 - 23	7.0	
23 - 30	12.5	
30 - 60	25.0	
60 - 80	8.0	
80 - 200	3.0	
200 - 2000	5.0	

NOTE: Sweep rate is 2 octaves/minute for all spectra

3.5.5 Random Motion Vibration

Gaussian random motion vibration shall be applied with the g-peaks clipped at three times the rms acceleration specified in the schedule

Random Motion Vibration Schedule

Frequency (Hr)	Acceleration (g-rms)	Test Duration (minutes per axis)	PSD LEVEL (g^2/Hz)
20-150	9.2	4	0.0225
150-300	9.2	4	Increasing from 150 Hz at constant rate of +3db
300-2000	9.2	4	0.045

3.5.6 Prelaunch Environment Conditions

The power conditioner shall not suffer detrimental affects from exposure to the following prelaunch environmental conditions:

a. Temperature: 75°F ± 5°F
b. Relative Humidity: 50 percent maximum
c. Duration: 3 weeks

3.5.7 Storage Temperature Condition

The power conditioner shall suffer no detrimental affects from exposure to temperatures in the range of 0°F to 130°F for storage durations of up to 3 years.

3.5.8 Attitude

The power conditioner shall be capable of operating in any attitude at 1-g or 0-g and shall be capable of operating after storage in any attitude at 1-g for three years.

3.5.9 The contractor shall design the power conditioner to operate as specified within the following operating environments.

3.5.10 Acceleration: The power conditioner shall be required to operate as specified under a sustained acceleration of thirteen (13) g's applied in the same direction as the plasma exhaust for a period of 5 years. Proper operation shall be possible at loads equivalent to 20 g's.

3.5.11 Temperature: The power conditioner shall be required to operate as specified when exposed to vacuum conditions with the temperature of the mounting structure and all of the surrounding surfaces (except where portions of the thruster are exposed to space) in the range from 0° F to 140° F as a steady state temperature or cycling between the extremes with a cyclic period greater than or equal to 6.2 hours.

3.5.12 Pressure: The power conditioner shall be required to operate as specified when the ambient pressure is less then 5×10^{-5} Torr. The power conditioner shall be designed to operate as specified when simultaneously exposed to the environments delineated above.

3.5.13 Reliability: High reliability is a prime requirement of this system. Simplicity of design shall be considered in the design. Particular emphasis shall be placed on those materials, techniques and components which offer high reliability and long life for spacecraft application.

3.5.14 Safety: The power conditioner shall be designed to minimize the hazard of electrical shock, fire and explosion on the spacecraft and during ground test.

3.5.15 Noise Susceptibility: The operation of the power conditioner shall not be disturbed nor performance degraded when the system is subjected to RF fields in the VHF-UHF band of as much as one volt per meter adjacent to the power conditioner. In addition, the system shall perform within specification when as much as one volt peak noise of 15 to 100 microseconds bursts is fed into the power supply bus.

3.5.16 Grounding: The circuit ground and chassis ground shall be maintained separately. The number of tie points for command return, telemetry return, and power return shall be minimized to preclude the possibility of ground loops.

3.5.17 EMI: Conducted EMI on the power bus, telemetry lines and command lines shall be kept as low as possible. All lines interfacing with the spacecraft shall contain EMI line filters. In addition, conducted and radiated EMI measurements shall be made at the spacecraft command and telemetry frequencies. VHF (135-149 MH Z) VHF (400-470 MHZ) S BAND (1670-2035 MHZ).

3.5.18 Connectors: Only two connectors shall be used on the power conditioner. One shall be provided for the spacecraft interface and the other for the hardwire (test points) interface. Both connectors shall adhere to the requirements of S-320-G-1 and GSFC S-311-P-10. Mating connectors shall be defined and disclosed to Fairchild Industries as soon as the connectors to be used on the power conditioner have been specified by the contractor, but in any case the disclosure shall be made no later than December 1, 1971. Extra pins on the connectors shall be used to double up on critical inputs such as SUPPLY VOLTAGE, ENABLE SIGNAL and the FIRE COMMAND SIGNAL.

3.6 DOCUMENTATION:

3.6.1 The drawings and documentation for the power conditioner shall be in accordance with the contractors standard engineering practice including the contractors release and control system. A bill of materials, in the contractors standard format, itemizing each component, subassembly and assembly drawing shall be provided.

The drawings and documentation, including the bill-of-materials, shall be of sufficient detail and of the type to:

a) Enable manufacture of the power conditioner, its subassemblies, components, etc

b) Procure components, subassemblies and assemblies for testing as may be required

c) Conduct failure analysis as may be required.

3.6.2 The contractor shall deliver with each flight prototype model power conditioner the following:

a) A complete updated set of engineering drawings

b) An operation/maintenance manual

c) Revisions to the model specification(if required)

d) A complete updated set of top-assembly and sub-assembly records

e) A preliminary report of the test data resulting from the ATP.

3.6.3 The contractor shall supply at least one photograph per S-253-P4 (STILL PHOTOGRAPHY).

3.7 MODEL SPECIFICATION

3.7.1 The contractor shall prepare and deliver a model specification of the flight prototype model power conditioner as specified herein. The model specification shall define all of the power conditioners operating parameters including

a) Weight

b) Size

c) Thermal Requirements and restraints

d) Mechanical Requirements and restraints

e) Interface Requirements and restraints

f) Electrical/Electronic Requirements and restraints

g) Performance requirements

This model specification is due at Fairchild Industries no later than November 25, 1971.

3.8 PARTS AND MATERIAL

3.8.1 Where possible, parts shall be selected per the GSFC Preferred Parts List, PPL-11. Parts selected for use on this program which do not appear on the GSFC PPL will be considered non-standarded and will require written approval by the GSFC Technical Officer for their intended use. All electronic parts will be screened, as a minimum, in accordance with the provisions of Appendix C of the GSFC PPL. The parts and materials list shall be submitted to Fairchild Industries with a copy to the GSFC Technical Officer for review thirty days prior to purchase of parts or release of drawings for fabrication.

3.9 TEST DATA

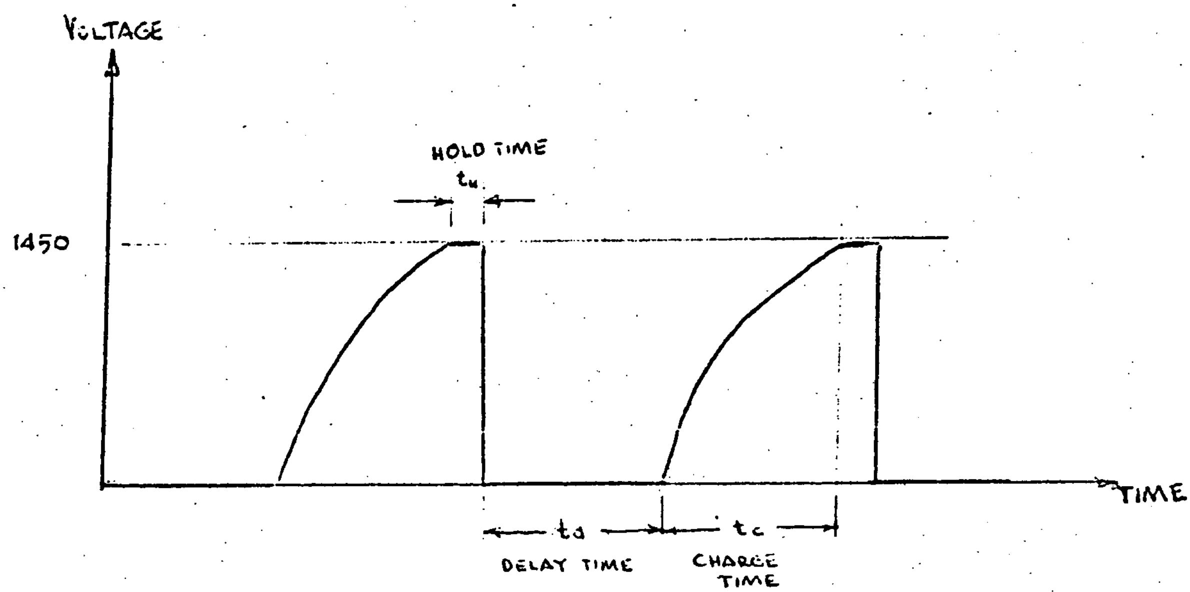
3.9.1 The power conditioner shall be tested by the contractor to verify its electrical performance to this specification. These tests shall consist of operation at low temperature (about 0° F), high temperature (about 140° F) and at room temperature (about 68° F) with data being taken at all three temperatures. The power conditioner shall accumulate at least 5 hours of operation before shipment to Fairchild Industries, Inc.

3.10 Weight: 698 GRAMS DESIGN GOAL 800 GRAMS MAXIMUM

3.11 DIMENSIONS: The power conditioner shall fit within the outlines of Fig. 2.

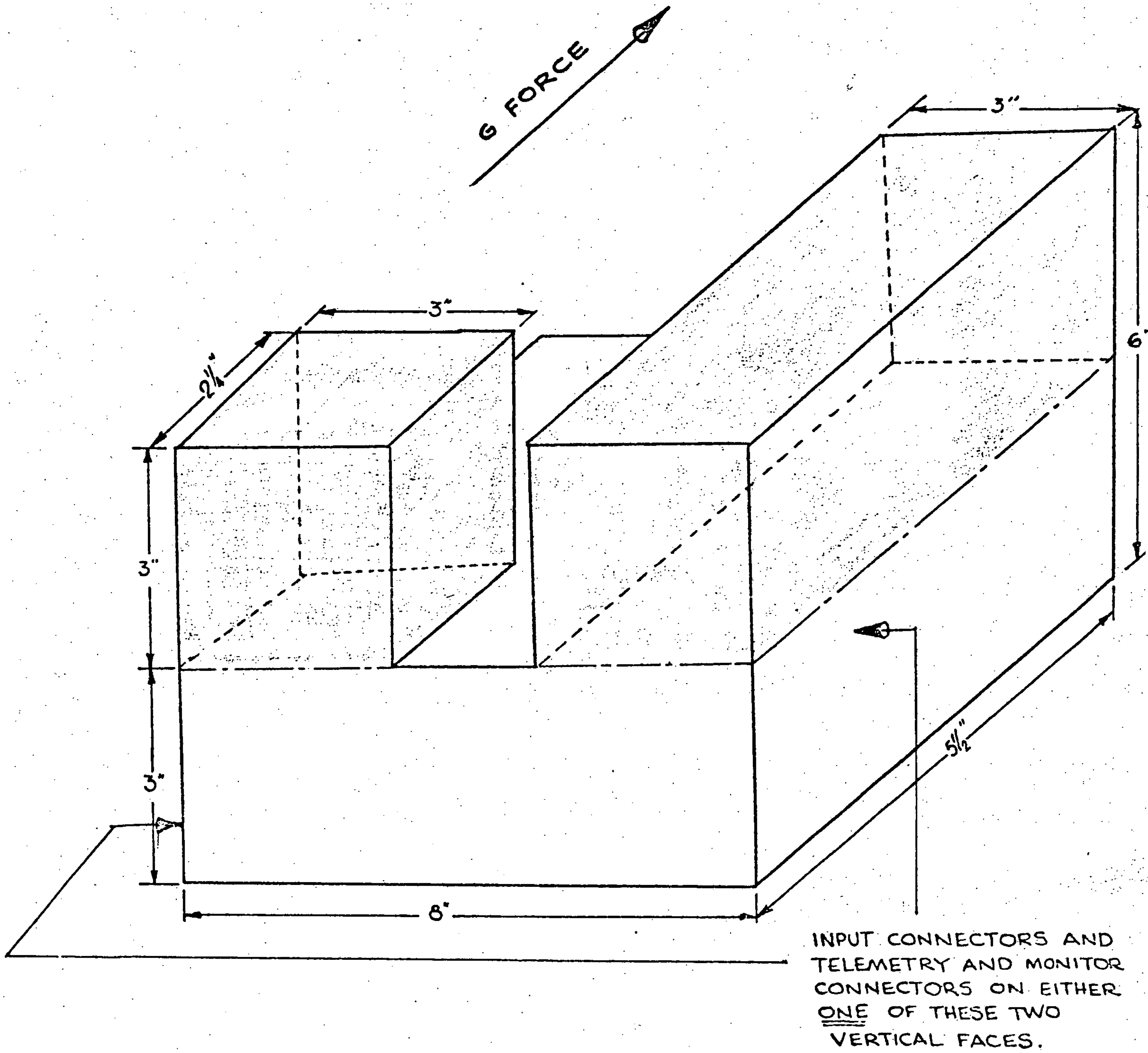
3.12 DESIGN LIFE: No design technique shall be used which would result in less than 20×10^6 charge discharge cycles.

3.13 MOUNTING PROVISIONS : The power conditioner shall be supplied with mounting provisions to be specified by Fairchild Industries soon after the inception of the program.



CAPACITOR VOLTAGE VS. TIME FOR LOW SPIN RATE WITH PULSE RATE SENSING.

FIGURE 1



OUTPUT CONNECTIONS TO THRUSTER PACKAGE
PREFERABLY WITHIN THE SHADED OUTLINES.

FIGURE 2

The following is Fairchild Industries/Fairchild Republic Division (FI/FRD) criteria for the derating of SMS Microthruster electronic, electrical and electro-mechanical parts. This criteria is a guide to ensure high inherent reliability and to prolong the useful life of parts. Exceptions to the criteria are permitted when based on sound engineering principles and judgment and with the written approval by FI/FRD.

Table 01. Derating Outline For Capacitors

Dielectric Class	Derate To	Remarks
Ceramic	50% of rated voltage	All capacitors: Except as noted below, capacitors shall not be used at ambient temperatures exceeding 85°C. The design shall also provide proper derating of capacitors operated under AC, pulse or transient voltages specified in applicable specifications.
Mica (Dipped)	60% of rated voltage	
Mica (Molded)	40% of rated voltage	
Paper	50% of rated voltage	
Mylar	75% of rated voltage	
Glass or Porcelain	50% of rated voltage	
Tantalum (Solid electrolytic) 3 ohm/volt surge limiting resistor	60% of rated voltage	
0.1 ohm/volt surge limiting resistor	40% of rated voltage	Ambient temperature shall not exceed 50°C.
Tantalum (Wet electrolytic)	70% of rated voltage	Ambient temperature shall not exceed 70°C.
Tantalum (Foil)	70% of rated voltage	Ambient temperature shall not exceed 70°C.

TABLE 02. DERATING OUTLINE OF CONNECTORS

Number of Contacts Used in Connector	Contact Size	Maximum Current per contact 1/ (Amperes) — Wire Size (AWG) 16	18	20	22	24	Remarks
1 to 4	16	13.0	9.2	6.5			All connectors: Maximum allowable operating voltage shall be 25% of the dielectric withstanding voltage rating for the anticipated environment.
1 to 4	20			6.0	4.5	3.3	
5 to 14	16	9.0	7.0	5.0			
5 to 14	20			5.0	3.5	2.7	
15 or more	16	6.5	5.0	3.7			
15 or more	20			3.7	2.5	2.0	

1/ Maximum current may be carried by only 10% of the contacts at one time. At such time, other contacts should be limited to 100 mA.

TABLE 03. DERATING OUTLINE OF EMI FILTERS

Class	Derate To	Remarks
All Filters	50% rated feed thru current and 50% rated DC working voltage	Ambient temperature shall not exceed 85 C.

TABLE 04 DERATING OUTLINE OF FUSES

(e. g., Littelfuse "Picofuse" & Bussmann "Tron")

Fuse Current Rating (Amperes)	Derate to the Following (%) of Rated Amperes 1/	Remarks
5	50%	Derating of fuses allows for possible loss of pressure, which lowers the blow current rating and allows for a decrease of current capability with time.
2	50%	
1	45%	
1/2	40%	
3/8	35%	
1/4	30%	

1/ Derating factors are based on data from fuses mounted on printed circuit boards and conformally coated.

TABLE 05. DERATING OUTLINE OF INDUCTORS AND TRANSFORMERS

Inductor Class per MIL-C-15305	Transformer Class per MIL-T-27	Maximum Operating 1/ Temperature (Ambient plus temp. rise)	Remarks
0	Q	65° C	Derate maximum winding voltage of all inductors and transformers to 50% of the manufacturers rated voltage.
A	R	85° C	
B	S	105° C	

1/ a) Maximum operating temperature equals ambient temperature + temperature rise + 10°C hot spot temperature
Temperature rise = $\frac{R-r}{r}(T+234.5)$ — R, is the resistance of winding under load;
r, is the resistance of winding without load at ambient temperature, T

b) The insulation classes of MIL style inductive parts have maximum operating temperature ratings which are generally based upon a life expectancy of at least 10,000 hrs. The maximum operating temperatures in this table are selected to extend the life expectancy by a factor of 5 beyond the MIL rating

c) Custom made inductive parts should be evaluated on a materials basis and stressed at levels which give maximum operating temperatures well below the rated maximums of the materials used. These should be commensurate with the deratings shown above for standard devices.

TABLE 06. DERATING OUTLINE OF RELAYS

Class	Derate To	Remarks
All Relays	50% of rated contact current	Users should be cautioned not to reduce coil current or voltage below that required for reliable operation.

TABLE 07. DERATING OUTLINE OF RESISTORS

Class	Derate To	Remarks
Carbon Composition (RCR)	50% of rated power	All resistors:
Film, General Purpose (RLR)	50% of rated power	a) Maximum voltage shall not exceed 80% of the maximum rated voltage on any resistor.
Film, High Stability (RNR)	50% of rated power	
Wirewound Accurate 1% Tolerance	50% of rated power	b) When two or more resistors are mounted so closely that heat from one resistor influences ambient conditions of another, they should be derated by an additional factor of 0.5.
0.5% Tolerance	35% of rated power	
0.1% Tolerance	25% of rated power	
Wirewound Power, chassis mount	30% of rated power	
Wirewound Power, (RWR)	50% of rated power	c) Resistors with weldable nickel leads shall be derated by an additional factor of 0.5.
Variable Trimmers	50% of rated power	

TABLE 08. DERATING OUTLINE OF DIODES

Class	Derate To*	Remarks
General Purpose	50% of rated power	All diodes:
Rectifier	20% of rated power 50% of rated forward current 50% of PIV	a) Derating factors are based on a 25°C ambient temperature. *b) Junction temperature shall not exceed 65% of $T_{j\,max}$. c) Peak inverse voltage or transients shall not exceed 80% of manufacturers rated value unless otherwise stated.
Reference Diode	20% of rated power	
Switching Diode	20% of rated power	
Silicon Controlled Rectifier	20% of rated power 50% of rated forward current	
Zener	50% of rated power	

TABLE 09A. DERATING OUTLINE OF SILICON TRANSISTORS

Class		Derate To*	Remarks
Low Power	NPN	20% of rated power	*Junction temperature shall not exceed 125°C for all applications. In the event of a conflict between this and the power derating factors, the 125°C limit shall govern.
Low Power	PNP	20% of rated power	Breakdown voltage for all devices should be derated to 75% BV_{ECO}, 75% BV_{EBO} and 75% BV_{CBO}.
High Power	NPN	15% of rated power	
Switching	NPN	20% of rated power	
Switching	PNP	20% of rated power	
Unijunction		20% of rated power	

TABLE 09B. DERATING OUTLINE OF FIELD EFFECT TRANSISTORS (FET)

Class	Derate To*	Remarks
General Purpose	40% of rated power	*Junction temperature shall not exceed 125°C for all applications.
High Speed Switch	40% of rated power	Breakdown voltage for all devices should be derated to 75% BV_{DSO}, 75% BV_{DGO} and 75% BV_{SGO}.
Medium Power	30% of rated power	
High Power	30% of rated power	

TABLE 10. DERATING OUTLINE OF INTEGRATED CIRCUITS

Class	Derate To	Remarks
Digital		The Manufacturer's suggested bias voltages shall not be derated unless precautions are taken to assure that such action does not cause possible malfunction.
1. AC and DC Fan-Outs	60% of Manufacturer max rating	
2. Combination of AC and DC Fan-Outs		
a) Load limits of AC levels	60% of Manufacturer max rating	
b) Load limits of DC levels	40% of Manufacturer max rating	

TABLE 14. DERATING OUTLINE OF THERMISTORS
(Temperature Sensitive Resistor)

Class	Derate To	Remarks
All Thermistors	50% of rated power	

TABLE 15. DERATING OUTLINE OF TRANSFORMERS
(See Table 05. Inductors and Transformers)

TABLE 16. DERATING OUTLINE OF WIRE AND CABLE

	Derate to - Amps, max.		
Wire Size	Bundle or Cable	Single	Remarks
26	1.4	2.5	1. Current ratings for bundles or cables are based on bundles of 15 or more wires at 70° C in a hard vacuum. In smaller bundles the allowable current may be increased as the bundle approaches a single wire. 2. Ratings are based on Teflon insulated wire (Type TFE)
24	2.0	3.3	
22	2.5	4.5	
20	3.7	6.5	
18	5.0	9.2	
16	6.5	13.0	
14	8.5	19.0	
12	11.5	25.0	
10	16.5	33.0	
8	23.0	44.0	

TABLE 17. DERATING OUTLINE OF QUARTZ CRYSTALS

Class	Derate To	Remarks
All Crystals	50% of rated drive level	

FAIRCHILD
REPUBLIC DIVISION

PC145S-8000
Amendment 1
17 December 1971

FAIRCHILD INDUSTRIES, INC.
FAIRCHILD REPUBLIC DIVISION
New Product Development Section
Farmingdale, New York 11735

PRODUCT SPECIFICATION FOR:

SMS POWER CONDITIONER

(AMENDMENT 1)

Prepared by: Robert Gelbman
R. Gelbman

Approved by: William J. Guman
W. J. Guman, Program Manager

PC145S8000
Amendment 1
17 December 1971

The following interpretations and clarifications of Fairchild Product Specification PC004S8000 -(PC145S8000), SMS Power Conditioner, are presented as Amendment 1.

Paragraph 3.3.1: The reference to two (2) 4.0 microfarad ± 10% capacitors is changed to read: two (2) 4.0 microfarad ± 5% capacitors. This change then agrees with the actual worst case tolerance of the capacitors that will be used. The charge time of 500 ± 20 milliseconds is changed to read: 500 ± 40 milliseconds. This change then agrees with the next sentence in the specification which says that the charge time shall not in any case exceed 540 milliseconds with 29.4 ± 0.2 volts input.

Paragraph 3.3.2: This paragraph will be interpreted as meaning that the two (2) 1.0 microfarad ± 5% capacitors connected in parallel shall be charged to 620 ± 20 volts D.C. in a charge time <u>not to exceed</u> 540 milliseconds.

Paragraph 3.3.5: Wilmore Electronics will plan for the 29.4-volt output which is supplied to the control logic to have a current capability of 25 milliamperes.

Paragraph 3.6.2: The following items will fulfill the Wilmore documentation requirements of 3.6.2 (a):

1. Complete Electrical Schematic and Parts List
2. Detailed Envelope Drawing defining outside dimensions, mounting arrangements, connector locations, etc.
3. Printed Circuit Board Layout Sheets showing the physical location of each electronic component and keying the component identifications to the schematic and parts list.
4. Telemetry calibration curves/data
5. Electrical test data (actually this is also covered in 3.6.2(e).

Paragraph 3.3.7: Fairchild Industries will provide the thermister to measure items 3.3.7d mean internal thruster temperature.

Paragraph 3.5.17: Conducted and radiated EMI measurements shall be performed by Fairchild Industries.

FOLDOUT FRAME 1

FOLDOUT FRAME 2

APPENDIX C. TENTATIVE DRAWINGS OF THRUSTER SUBASSEMBLY

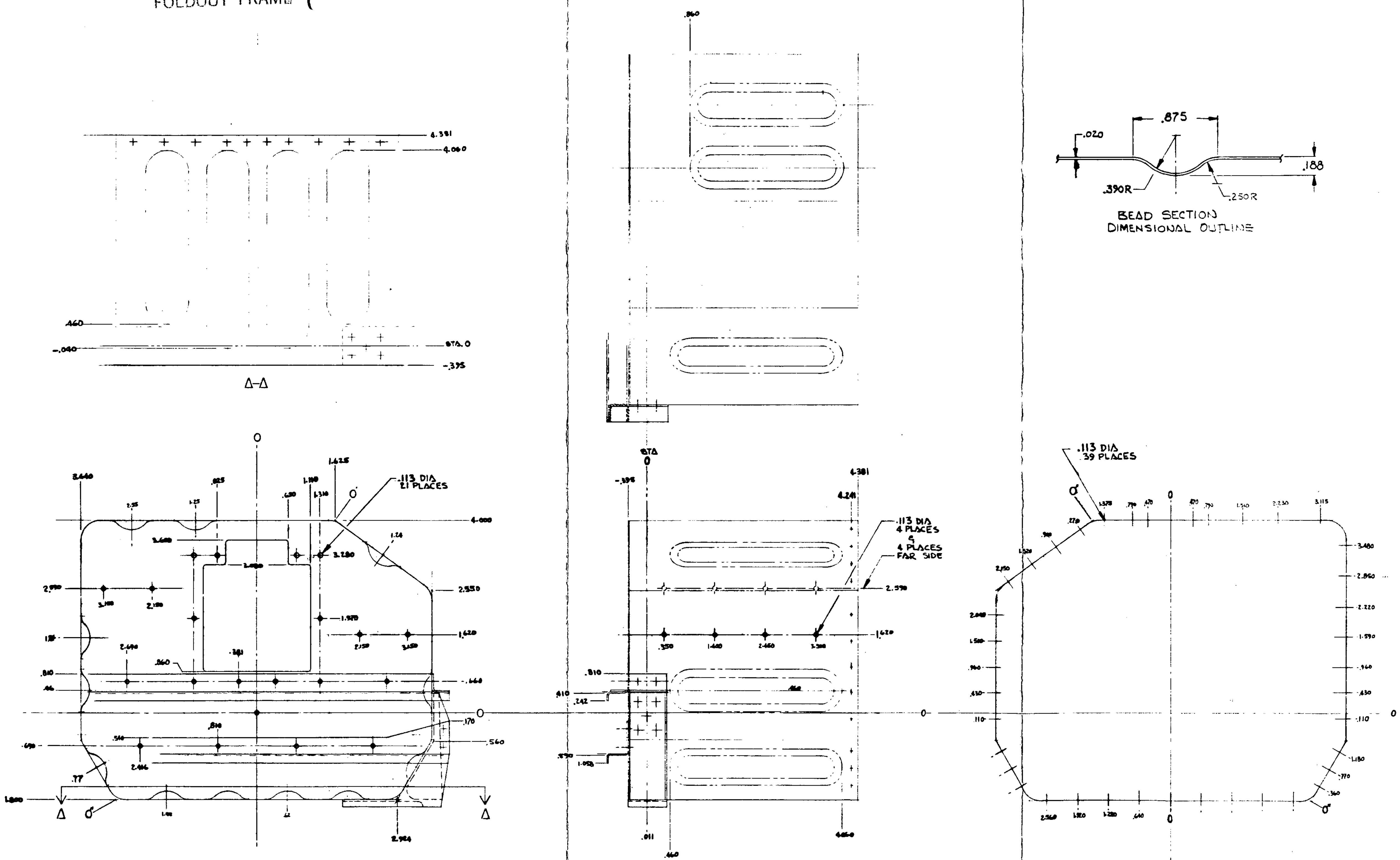


Figure 9. Housing Assembly

FOLDOUT FRAME 1

FOLDOUT FRAME 2

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PC145D1013

TYPE OF CHANGE	EAI INC	REWORK PERMIT YES	REWORK PERMIT NO	ZONE	LTR.	REVISIONS DESCRIPTION	DATE	APPROVED

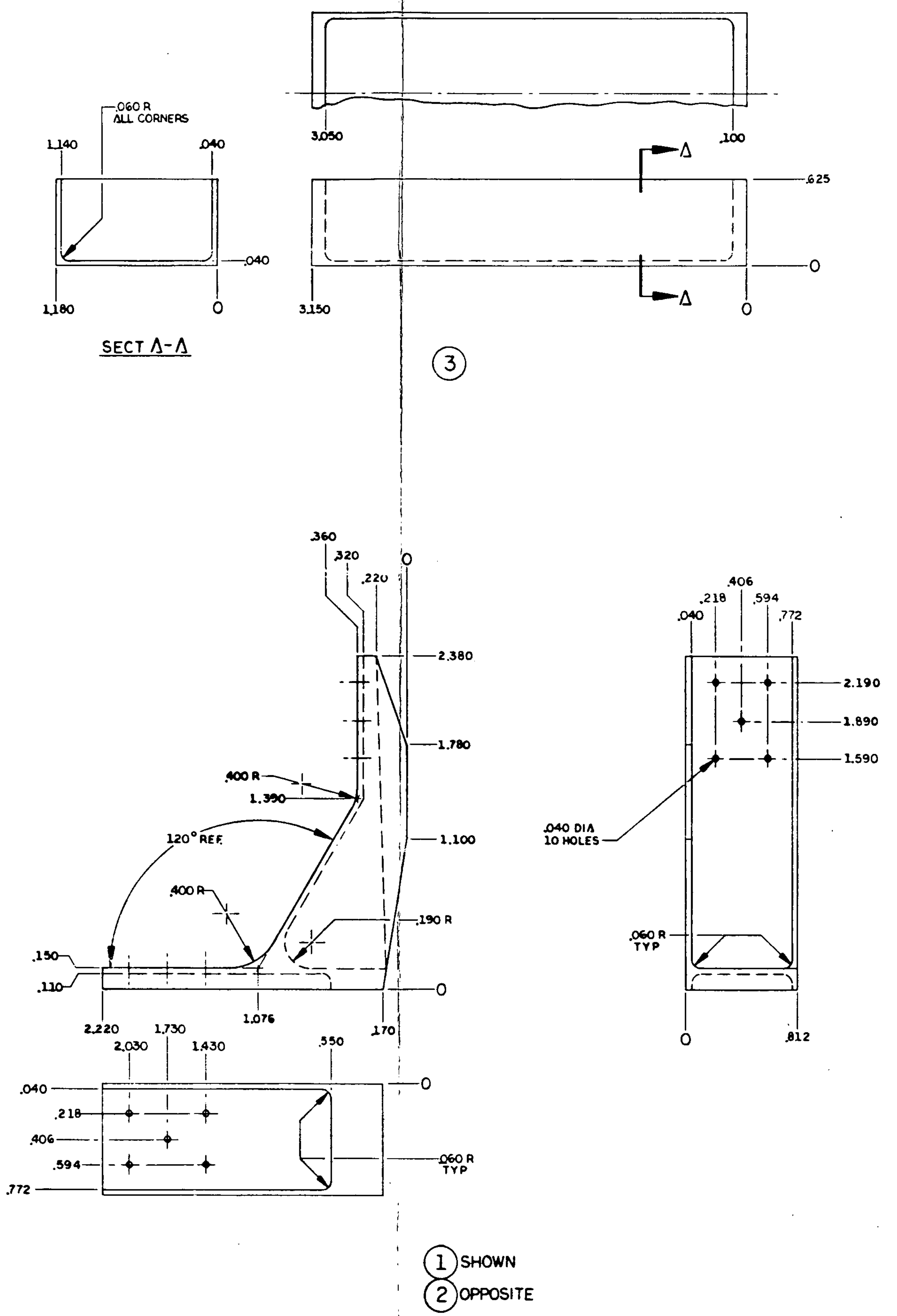


Figure 10. Forward Mount, Aft Mount

QUANTITY REQD				SYM	VENDOR DATA PER.	CODE IDENT	PART OR IDENTIFYING NO.	ZONE	NOMENCLATURE OR DESCRIPTION	DIA	THICK	WIDTH	LENGTH	MATERIAL	MATL SPECIFICATION	TS 1000 PSI	UNIT WT
				3			-3		MOUNT AFT		1.00	1.3	3.3	6061-T6 AL ALY BAR	QQ-A-200/8c		
				2			-2		MOUNT FWD L/H		1.00	2.8	2.8	6061-T6 AL ALY PLATE	QQ-A-200/11d		
				1			PC145D1013-1		MOUNT FWD R/H		1.00	2.8	2.8	6061-T6 AL ALY PLATE	QQ-A-200/11d		

STOCK SIZE

LIST OF MATERIAL

PART NUMBER MARKING PER MIL-STD-130

UNAUTHORIZED USE, MANUFACTURE OR REPRODUCTION IN WHOLE OR IN PART IS PROHIBITED. DRAWING, DESIGN AND OTHER DISCLOSURES PROPERTY OF FAIRCHILD HILLER CORPORATION.

NEXT ASSEMBLY	USED ON	NEXT ASSY	FINAL ASSY
PC145D1005	SMS MICROTHRUSTER		1 OF 3
PC145D1010	SMS MICROTHRUSTER		1 OF 2 & 1 OF 1
APPLICATION		QUANTITY REQD	

DIMENSIONS ARE IN INCHES
UNLESS OTHERWISE NOTED

DEC TOL	SH MET. RAD
2 PLACE ±	BEND:
3 PLACE ±.005	COR:
ANGULAR ±	DEBURR ALL EDGES

APPLICABLE SPECIFICATIONS
FINISH:
HEAT TREAT:
BEND RELIEF:
FOR ADDL SPEC SEE NOTE

DO NOT SCALE DRAWING

DRAWN
CHECKED
GR ENGR
STRUCT
WEIGHTS
PROJ ENGR

CONTRACT NO.
NAS-5-11494

FAIRCHILD HILLER
REPUBLIC AVIATION DIVISION
FARMINGDALE, 11735 NEW YORK

MOUNTS-MAIN
SMS THRUSTER

SIZE	CODE IDENT NO.		REV.
D	77751	PC145D1013	

SCALE TWICE | SHEET

FORM RAI 142A

C-2

C-2.1

FOLDOUT FRAME 1

FOLDOUT FRAME 2

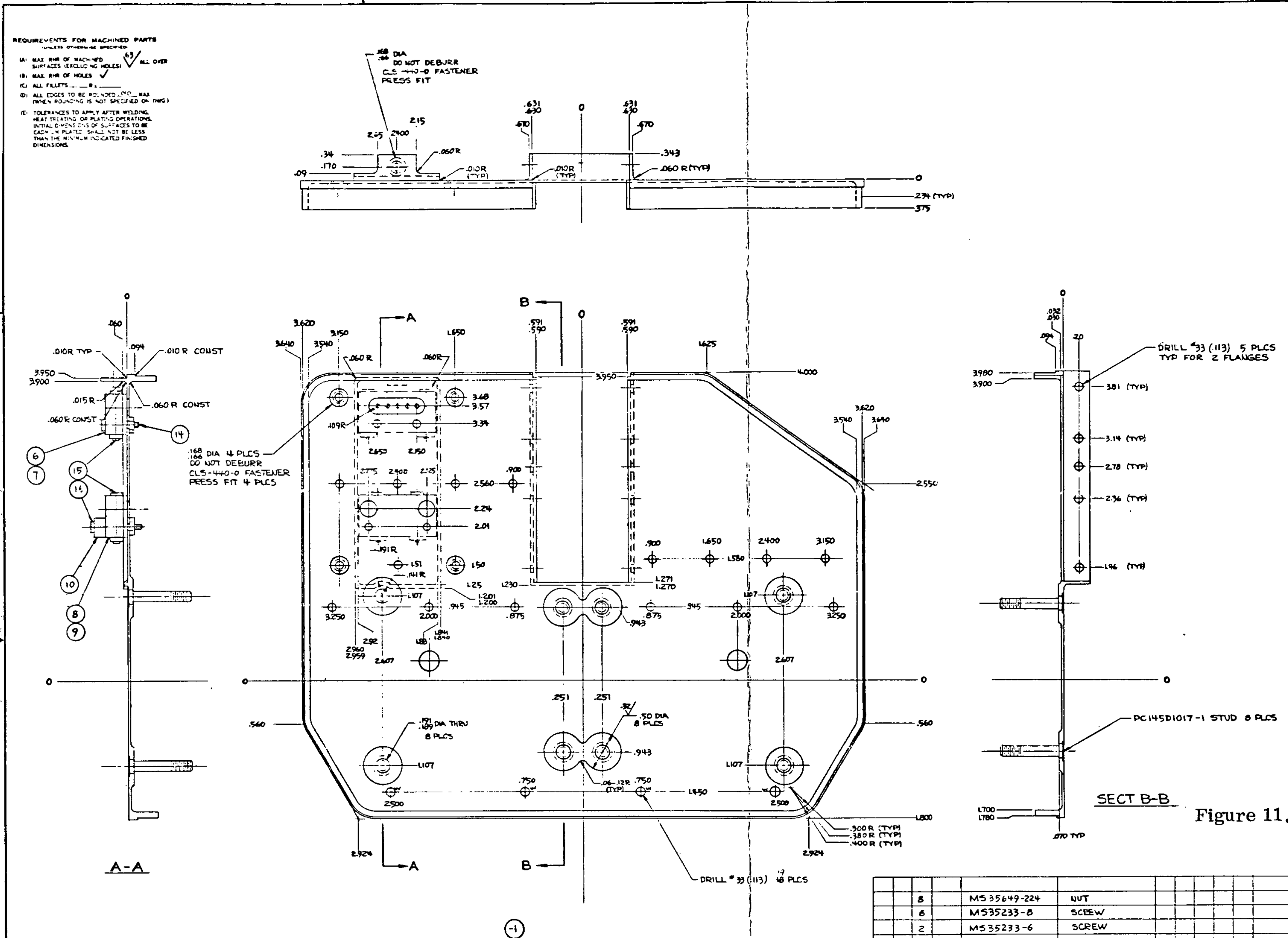


Figure 11. Bulkhead Assembly, Enclosure

QUANTITY REQD	CODE IDENT	PART NO. OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	ZONE	STOCK SIZE	MATERIAL / MATERIAL SPECIFICATION / CONDITION VENDOR NAME AND ADDRESS	LINE NO.
							17
8		MS35649-224	NUT				16
6		MS35233-8	SCREW				15
2		MS35233-6	SCREW				14
							13
							12
8		PC145D1017-1	STUD				11
1		PC145D1062-27	INSULATER				10
1		PC145D1062-25					9
1		PC145D1062-23					8
1		PC145D1062-21					7
1		PC145D1062-19	INSULATOR				6
8		PC145D1017-1	STUD				5
1		-11	BULKHEAD		.575 68 8.0	AL ALY 6061-T6 PL QQ-A-250/11	4
							3
		PC145D1015-1	BULKHEAD ASSY				2
-1			ASSEMBLIES				1

LIST OF MATERIAL

PART NUMBER MARKING PER MIL-STD-130

NEXT ASSEMBLY	USED ON	NEXT ASSY	FINAL ASSY
PC145D1005	SMS MICROTHRUSTER		1 OF -1

DO NOT SCALE DRAWING. ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED

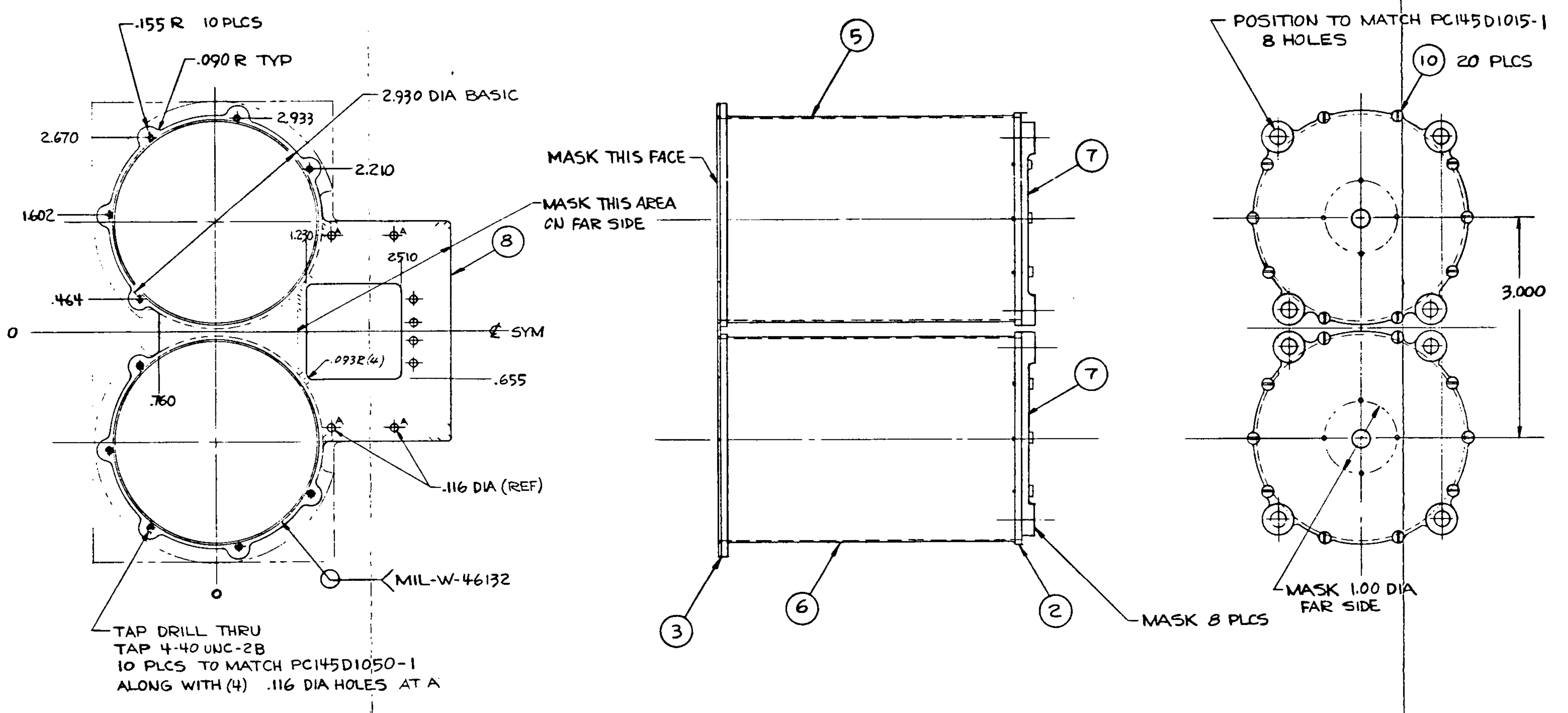
CONTRACT NO. NAS-5-11494

FAIRCHILD HILLER
FAIRCHILD REPUBLIC DIVISION

BULKHEAD ASSY – SMS MICROTHRUSTER

SIZE E | CODE IDENT NO. 77751 | PC145D1015

PC145D1015



NOTES

1. ELECTRON BEAM WELD PER MIL-W-46132
2. LIGHTLY SAND BLAST -1 ON ALL SURFACES NOT MASKED OFF. AFTER CLEANING, APPLY POLYURETHANE COATING TO ALL SAND BLASTED SURFACES

Figure 12. Capacitor Case Assembly, Case, Cover

QUANTITY REQD			CODE IDENT	PART NO. OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	ZONE	STOCK SIZE DIA	THICK	WIDTH	LENGTH	MATERIAL / MATERIAL SPECIFICATION / CONDITION VENDOR NAME AND ADDRESS	PROCESS SPECIFICATION LINE NUMBERS	FINISH CODE	MARK CODE	FIELD NOTES	TRACE CODE	LINE NO.
																	12
		✓	30676	Z 306	CHEMGLAZE POLYURETHANE COATING						(HUGHSON CHEMICAL CO. ERIE, PA)						11
		20		MS 35233-3	SCREW												10
																	9
	1			PC 145D1023-1	COLLECTOR PLATE												8
		2		PC 145D1022-1	COVER												7
	1			PC 145D1021-2	CASE												6
	1			PC 145D1021-1	CASE												5
																	4
		1		-3	WELD ASSEMBLY										1		3
				PC145D1020-1	CASE ASSEMBLY												2
	-3	-1			ASSEMBLIES												1

LIST OF MATERIAL

PART NUMBER MARKING PER MIL-STD-130

NEXT ASSEMBLY	USED ON	NEXT ASSY	FINAL ASSY
PC145D1005	SMS MICROTHRUSTER		1 OF-1

APPLICATION | QUANTITY REQD

WEIGHTS
TOTAL WEIGHTS
DASH NO.
WEIGHT

DO NOT SCALE DRAWING
ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED.
TOLERANCES UNLESS NOTED
XX±.01 XXX±.005 ANG±

LAYOUT BY
DRAWN BY J. CHUNG 4-5-72
CHECKED
ENGINEER
STRUCTURES
APPROVED

CONTRACT NO. NAS-5-11494

FAIRCHILD HILLER
FAIRCHILD REPUBLIC DIVISION
FARMINGDALE, NEW YORK 11735

CASE ASSEMBLY-
CAPACITOR
SMS MICROTHRUSTER

SIZE D | CODE IDENT NO. 77751 | PC145D1020

SCALE | SHEET 1 OF

FR-S-12 DC

PC145D1020

REVISIONS

TYPE OF CHANGE	EA: INC	REWORK PERMIT YES	NO	ZONE	LTR	DESCRIPTION	DATE	APPROVED

C-6

C-7

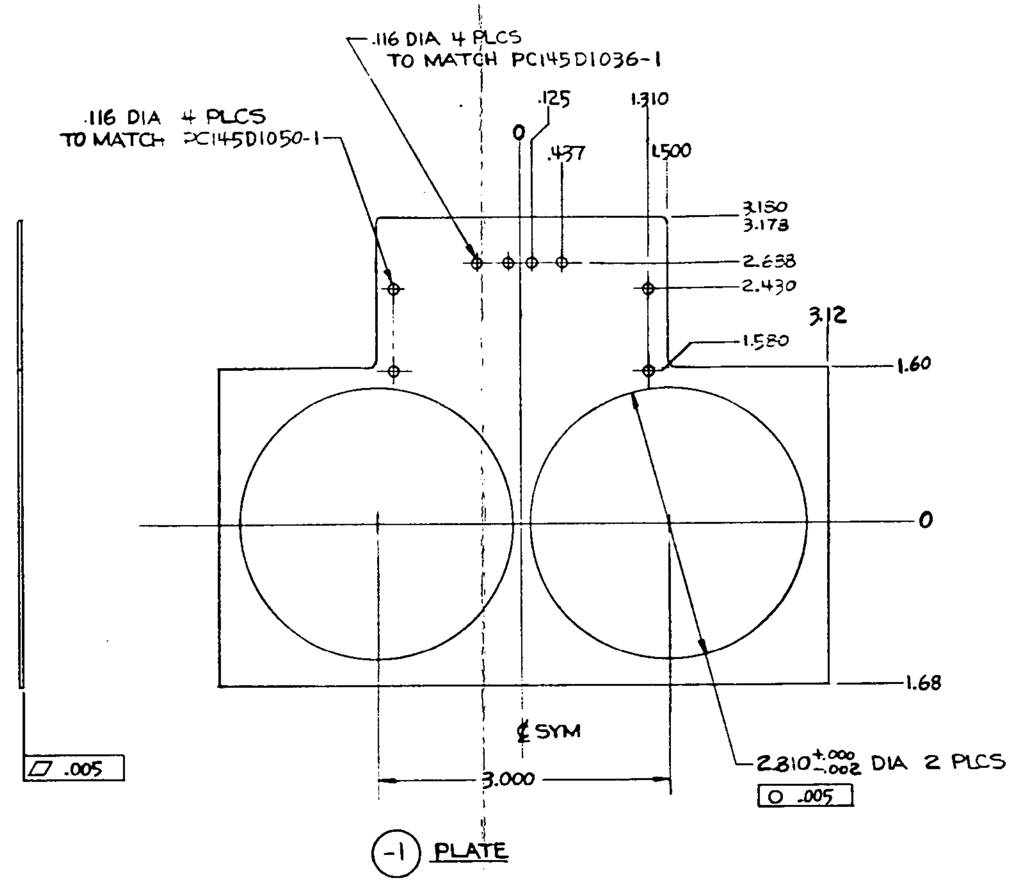


Figure 13. Collector Plate, Negative

PC145D1023

REVISIONS

TYPE OF CHANGE	EAI INC	REWORK PERMIT YES NO	SYM	DESCRIPTION	DATE	APPROVED

QUANTITY REQD	SYM	VENDOR DATA PER	CODE IDENT	PART OR IDENTIFYING NO.	ZONE	NOMENCLATURE OR DESCRIPTION	DIA	THICK	WIDTH	LENGTH	MATERIAL	MATL SPECIFICATION	TS 1000 PSI	UNIT WT
				PC145D1023-1		COLLECTOR PLATE		.040	5.0	6.4	AL ALY 6061-T6 SH	QQ-A-250/11		

LIST OF MATERIAL

PART NUMBER MARKING PER MIL-STD-130

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DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED
DEC TOL: 2 PLACE ±.01; 3 PLACE ±.005; ANGULAR ±
SH MET. RAD: BEND: ; COR: .06; DEBURR ALL EDGES
APPLICABLE SPECIFICATIONS
FINISH:
HEAT TREAT:
BEND RELIEF:
FOR ADDL SPEC SEE NOTE
DO NOT SCALE DRAWING

DRAWN J.CHUNG 4-6-72
CHECKED
GR ENGR
STRUCT
WEIGHTS
PROJ ENGR

CONTRACT NO. NAS-5-11494

FAIRCHILD HILLER
REPUBLIC AVIATION DIVISION
FARMINGDALE, LONG ISLAND, NEW YORK

COLLECTOR PLATE - NEGATIVE
SMS MICROTHRUSTER

SIZE C | CODE IDENT NO. 77751 | PC145D1023
SCALE FULL UNLESS OTHERWISE NOTED | SHEET

NEXT ASSEMBLY	USED ON	NEXT ASSY	FINAL ASSY
PC145D1020	SMS MICROTHRUSTER		1 OF -1

APPLICATION | QUANTITY REQD

FORM RAD 141

C-8

FOLDOUT FRAME 1

FOLDOUT FRAME 2

REVISIONS							
TYPE OF CHANGE	EAI INC	REWORK PERMIT YES	REWORK PERMIT NO	SYM	DESCRIPTION	DATE	APPROVED

PC145D1025

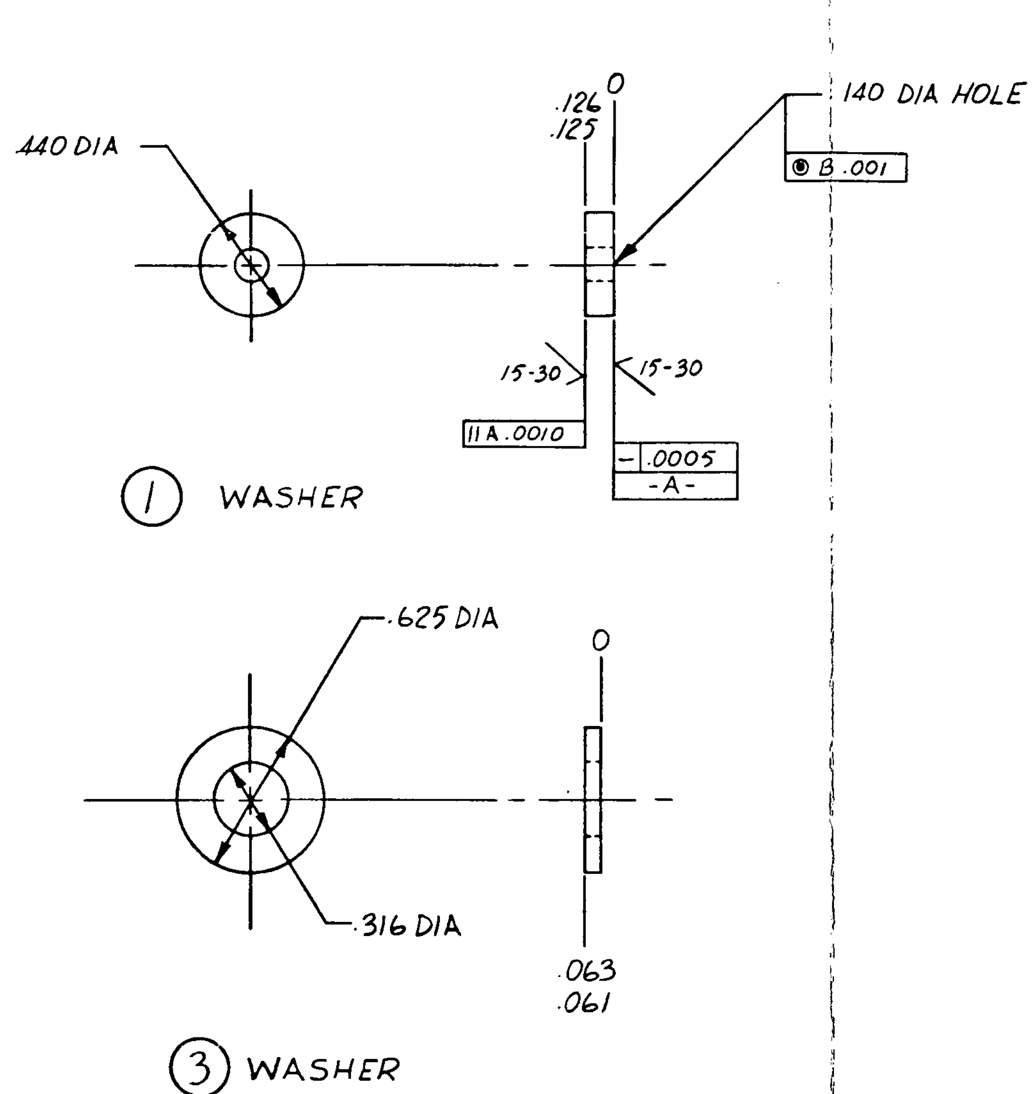

Figure 14. Standoffs, Thermal

QUANTITY REQD				SYM	VENDOR DATA PER	CODE IDENT	PART OR IDENTIFYING NO.	ZONE	NOMENCLATURE OR DESCRIPTION	DIA	THICK	WIDTH	LENGTH	MATERIAL	MATL SPECIFICATION	TS 1000 PSI	UNIT WT
				3			-3			.625			.1				
				2													
				1			PC145D1025-1		WASHER	440			.2	THERMALOX 995	BRUSH WELLMAN INC, ELMORE, OHIO	4341	6

STOCK SIZE

LIST OF MATERIAL

PART NUMBER MARKING PER MIL-STD-130

NEXT ASSEMBLY	USED ON	NEXT ASSY	FINAL ASSY
PC145D1060			2 OF -3
PC145D1005			8 OF -1

APPLICATION | QUANTITY REQD

DIMENSIONS ARE IN INCHES
UNLESS OTHERWISE NOTED

DEC TOL	SH MET. RAD
2 PLACE ±.	BEND:
3 PLACE ± .002	COR:
ANGULAR ±	DEBURR ALL EDGES

APPLICABLE SPECIFICATIONS

FINISH: NONE
HEAT TREAT:
BEND RELIEF:
FOR ADDL SPEC SEE NOTE

DO NOT SCALE DRAWING

DRAWN	DeFRANCO, J	2/23/71
CHECKED	[illegible]	30 Mar 71
GR ENGR		
STRUCT		
WEIGHTS		
PROJ ENGR		

CONTRACT NO. NAS-5-11494

FAIRCHILD HILLER
REPUBLIC AVIATION DIVISION
FARMINGDALE, LONG ISLAND, NEW YORK

WASHERS - THERMAL, SOLID PROPELLANT MICROTHRUSTER

SIZE	CODE IDENT NO.	
C	77751	PC145D1025

SCALE 2/1 | UNLESS OTHERWISE NOTED | SHEET

PC145D1025

FORM RAD 141

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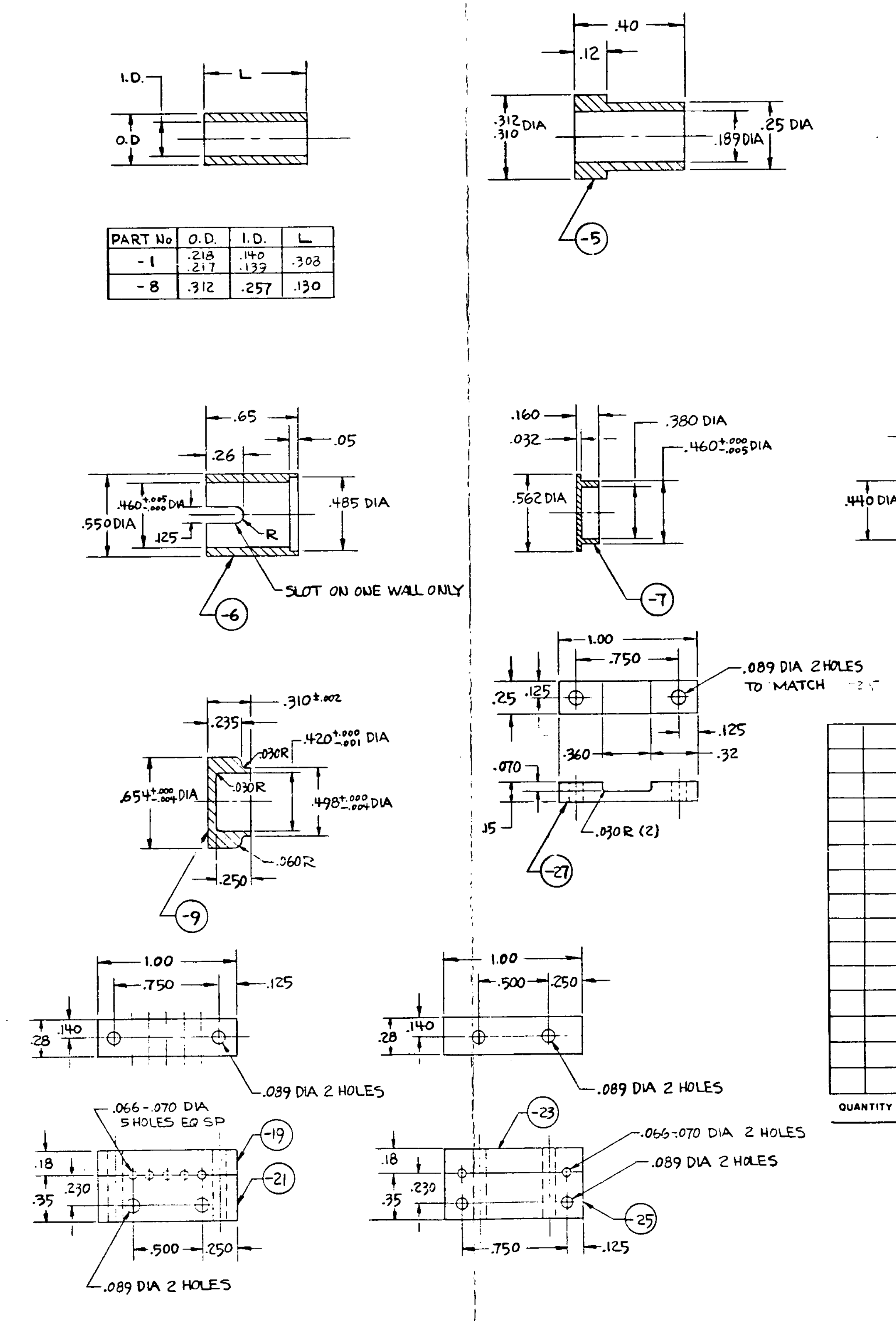
FOLDOUT FRAME 1

FOLDOUT FRAME 2

TYPE OF CHANGE	EAI INC	REWORK PERMIT YES	NO	ZONE	LTR	REVISIONS DESCRIPTION	DATE	APPROVED

REQUIREMENTS FOR MACHINED PARTS
(UNLESS OTHERWISE SPECIFIED)

(A) MAX. RHR OF MACHINED SURFACES (EXCLUDING HOLES) 63 ✓ ALL OVER
(B) MAX. RHR OF HOLES ✓
(C) ALL FILLETS .015 R ± .005
(D) ALL EDGES TO BE ROUNDED .010 MAX. (WHEN ROUNDING IS NOT SPECIFIED ON DWG.)
(E) TOLERANCES TO APPLY AFTER WELDING, HEAT TREATING, OR PLATING OPERATIONS. INITIAL DIMENSIONS OF SURFACES TO BE CADMIUM PLATED, SHALL NOT BE LESS THAN THE MINIMUM INDICATED FINISHED DIMENSIONS.
(F) APPLY PART NUMBER & INSPECTOR'S STAMP PER STANDARD PROCEDURES FOR SMALL PARTS



PART No	O.D.	I.D.	L
-1	.218 .217	.140 .139	.308
-8	.312	.257	.130

PART No	O.D.	I.D.	L	T
-3	.216	.113	.130	.025
-4	.216	.113	.060	.025

NOTES:
1. PACKAGE TOGETHER -19 & -21 AS A MATCHED SET.
   "   "   -23 & -25 "   "   "   " .

Figure 15. Insulators

QUANTITY REQD				CODE IDENT	PART NO. OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	ZONE	STOCK SIZE DIA	THICK	WIDTH	LENGTH	MATERIAL / MATERIAL SPECIFICATION / CONDITION VENDOR NAME AND ADDRESS	PROCESS SPECIFICATION LINE NUMBERS	FINISH CODE	MARK CODE	FIELD NOTES	TRACE CODE	LINE NO.
					-27	INSULATOR			.25	.2	1.1	EPOXY RESIN GLASS FABRIC LAMINATE NEMA GRADE G-10 MIL-P-18177-GEE						
					-25	↑			.32	.4	1.1	↑				1		13
					-23				.25	.4	1.1					1		12
					-21				.32	.4	1.1					1		11
					-19				.25	.4	1.1					1		10
					-9			.75			.4							9
					-8			.37			.2							8
					-7			.62			.2							7
					-6			.62			.7							6
					-5			.37			.5							5
					-4			.25			.1							4
					-3			.25			.2							3
					-2	↓		.50			.09	↓						2
					PC145D1026-1	INSULATOR		.25			.4	EPOXY RESIN GLASS FABRIC LAMINATES NEMA GRADE G-10 MIL-P-18177-GEE						1

LIST OF MATERIAL

PC145D1026

PART NUMBER MARKING PER MIL-STD-130

NEXT ASSEMBLY	USED ON	NEXT ASSY	FINAL ASSY
PC145D1015	SMS MICROTHRUSTER		1 EA OF -19 -21-23-25-27
PC145D1054	↑		2 OF -9
PC145D1060			2 OF -8
PC145D1035			2 OF -6
PC145D1030			1 OF -5
PC145D1050	↓		2 OF -3 1 OF -4
PC145D1005	SMS MICROTHRUSTER		3 EA -1 & -2 2 OF -7
APPLICATION		QUANTITY REQD	

WEIGHTS
TOTAL WEIGHTS
DASH NO.
WEIGHT

DO NOT SCALE DRAWING
ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED.
TOLERANCES UNLESS NOTED
XX±.01 XXX±.005 ANG± 1°

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LAYOUT BY	
DRAWN BY	J. CHOUG 5-15-72
CHECKED	
ENGINEER	
STRUCTURES	
APPROVED	
CONTRACT NO.	NAS-5-11494

FAIRCHILD HILLER
FAIRCHILD REPUBLIC DIVISION
FARMINGDALE, NEW YORK 11735

INSULATOR DETAILS-
SMS MICROTHRUSTER

SIZE D CODE IDENT NO. 77751 PC145D1026

SCALE 2/1 SHEET 1 OF

FR-S-12 DC

C-12 C-13

FOLDOUT FRAME 1

FOLDOUT FRAME 2

PC145D1032

TYPE OF CHANGE	EAI INC	REWORK PERMIT YES	REWORK PERMIT NO	SYM	REVISIONS DESCRIPTION	DATE	APPROVED

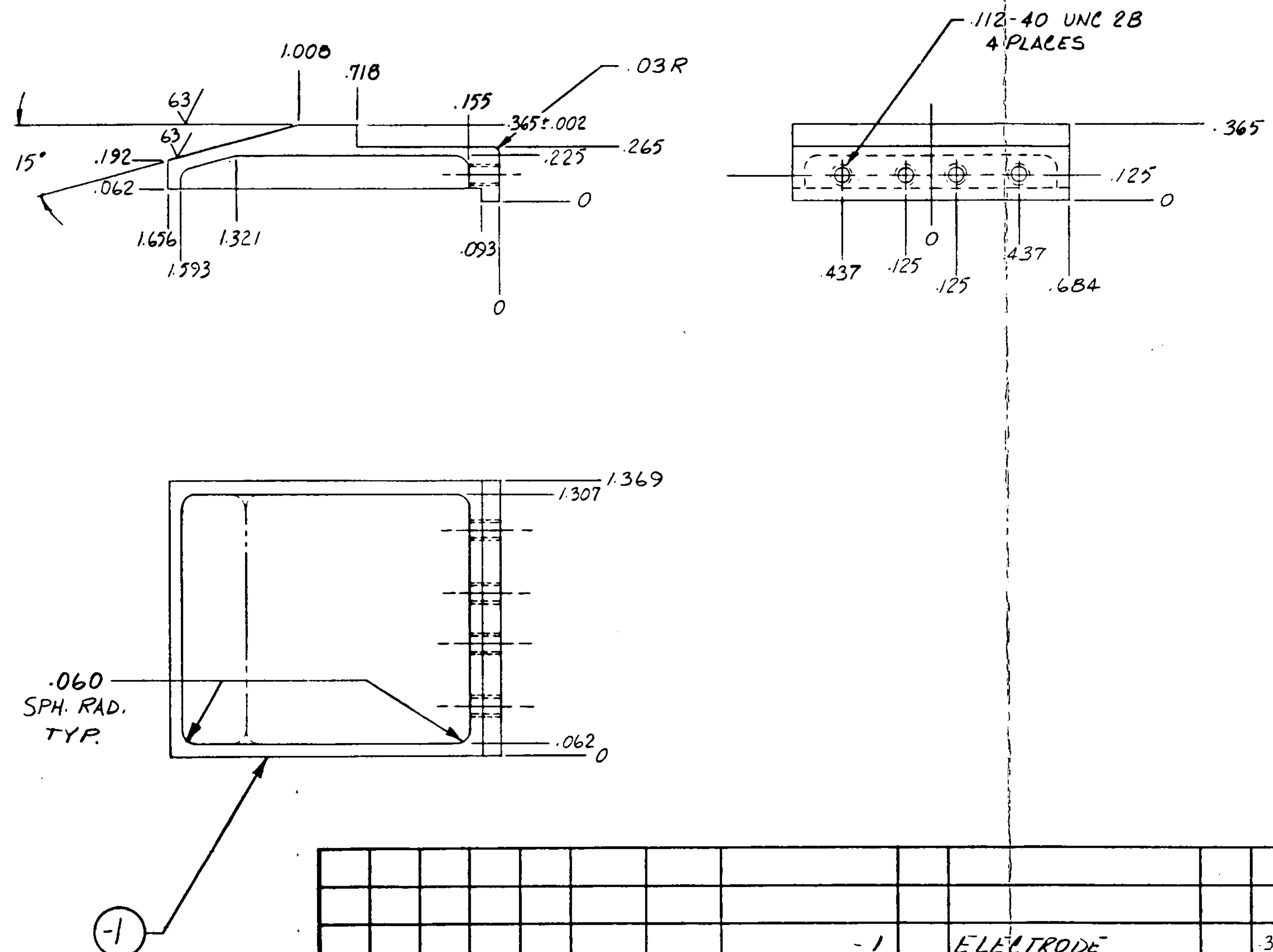


Figure 16. Electrode-Positive

PC145D1032

QUANTITY REQD	SYM	VENDOR DATA PER	CODE IDENT	PART OR IDENTIFYING NO.	ZONE	NOMENCLATURE OR DESCRIPTION	STOCK SIZE DIA	STOCK SIZE THICK	STOCK SIZE WIDTH	STOCK SIZE LENGTH	MATERIAL	MATL SPECIFICATION	TS 1000 PSI	UNIT WT
				-1		ELECTRODE		.375	1.5	1.8	17-7 PH STAINLESS STEEL	MIL-S-25043 COND A		

LIST OF MATERIAL

PART NUMBER MARKING PER MIL-STD-130

UNAUTHORIZED USE, MANUFACTURE OR REPRODUCTION IN WHOLE OR IN PART IS PROHIBITED. DRAWING, DESIGN AND OTHER DISCLOSURES PROPERTY OF FAIRCHILD HILLER CORPORATION.

NEXT ASSEMBLY	USED ON	NEXT ASSY	FINAL ASSY
PC145D1031			
APPLICATION		QUANTITY REQD	

DIMENSIONS ARE IN INCHES
UNLESS OTHERWISE NOTED

DEC TOL | SH MET. RAD
2 PLACE ±. | BEND:
3 PLACE ±. | COR:
ANGULAR ± | DEBURR ALL EDGES

APPLICABLE SPECIFICATIONS

FINISH:
HEAT TREAT:
BEND RELIEF:
FOR ADDL SPEC SEE NOTE

DO NOT SCALE DRAWING

DRAWN 12/22
CHECKED
GR ENGR
STRUCT
WEIGHTS
PROJ ENGR

CONTRACT NO. NAS-5-11494

FAIRCHILD HILLER
REPUBLIC AVIATION DIVISION
FARMINGDALE, LONG ISLAND, NEW YORK

ELECTRODE-POSITIVE

SIZE C | CODE IDENT NO. 77751 | PC145D1032

SCALE 2/1 | UNLESS OTHERWISE NOTED | SHEET

FORM RAD 141

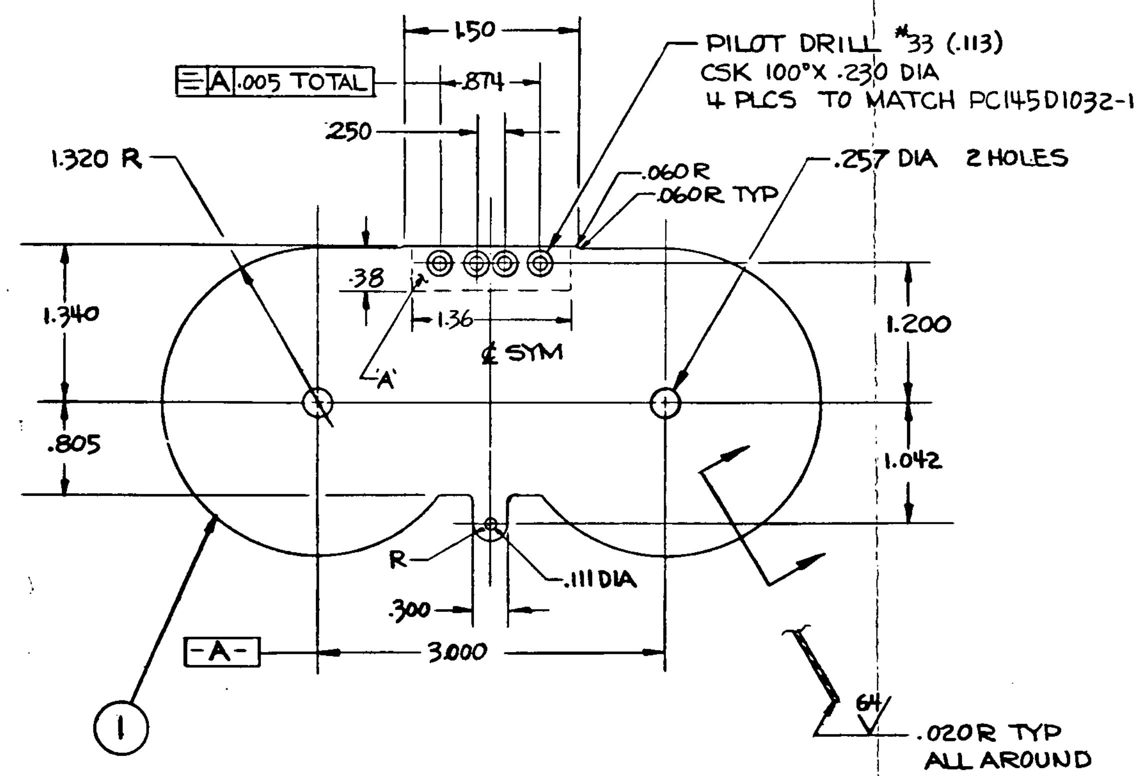
C-14

FOLDOUT FRAME /

FOLDOUT FRAME 2

PC145D1033

REVISIONS							
TYPE OF CHANGE	EAI INC	REWORK PERMIT YES	NO	SYM	DESCRIPTION	DATE	APPROVED



NOTES:
1. LIGHTLY SANDBLAST BOTH SIDES OF -1 EXCEPT IN AREA 'A' (FAR SIDE)

Figure 17. Collector Plate-Positive

PC145D1033

QUANTITY REQD				SYM	VENDOR DATA PER	CODE IDENT	PART OR IDENTIFYING NO.	ZONE	NOMENCLATURE OR DESCRIPTION	DIA	THICK	WIDTH	LENGTH	MATERIAL	MATL SPECIFICATION	TS 1000 PSI	UNIT WT
				3													
				2													
				1			PC145D1033-1		COLLECTOR PLATE		.040	3.0	6.0	AL ALY 6061-T6 SH	QQ-A-250/11		

STOCK SIZE

LIST OF MATERIAL

PART NUMBER MARKING PER MIL-STD-130

UNAUTHORIZED USE, MANUFACTURE OR REPRODUCTION IN WHOLE OR IN PART IS PROHIBITED. DRAWING, DESIGN AND OTHER DISCLOSURES PROPERTY OF FAIRCHILD HILLER CORPORATION.

NEXT ASSEMBLY	USED ON	NEXT ASSY	FINAL ASSY
PC145D1030	SMS MICROTHRUSTER	1 OF -1	1 OF -1

APPLICATION | QUANTITY REQD

DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED

DEC TOL	SH MET. RAD
2 PLACE ± .01	BEND:
3 PLACE ± .005	COR:
ANGULAR ±	DEBURR ALL EDGES

APPLICABLE SPECIFICATIONS

FINISH:
HEAT TREAT:
BEND RELIEF:
FOR ADDL SPEC SEE NOTE

DO NOT SCALE DRAWING

DRAWN	J. CHUNG	4-26-72
CHECKED		
GR ENGR		
STRUCT		
WEIGHTS		
PROJ ENGR		

CONTRACT NO. NAS-5-11494

FAIRCHILD HILLER
REPUBLIC AVIATION DIVISION
FARMINGDALE, LONG ISLAND, NEW YORK

COLLECTOR PLATE-POSITIVE
SMS MICROTHRUSTER

SIZE C | CODE IDENT NO. 77751 | PC145D1033

SCALE FULL UNLESS OTHERWISE NOTED | SHEET

FORM RAD 141

C-16

FOLDOUT FRAME 1

FOLDOUT FRAME 2

PC145D1034

REVISIONS								
TYPE OF CHANGE	EAI INC	REWORK PERMIT YES	NO	ZONE	LTR	DESCRIPTION	DATE	APPROVED

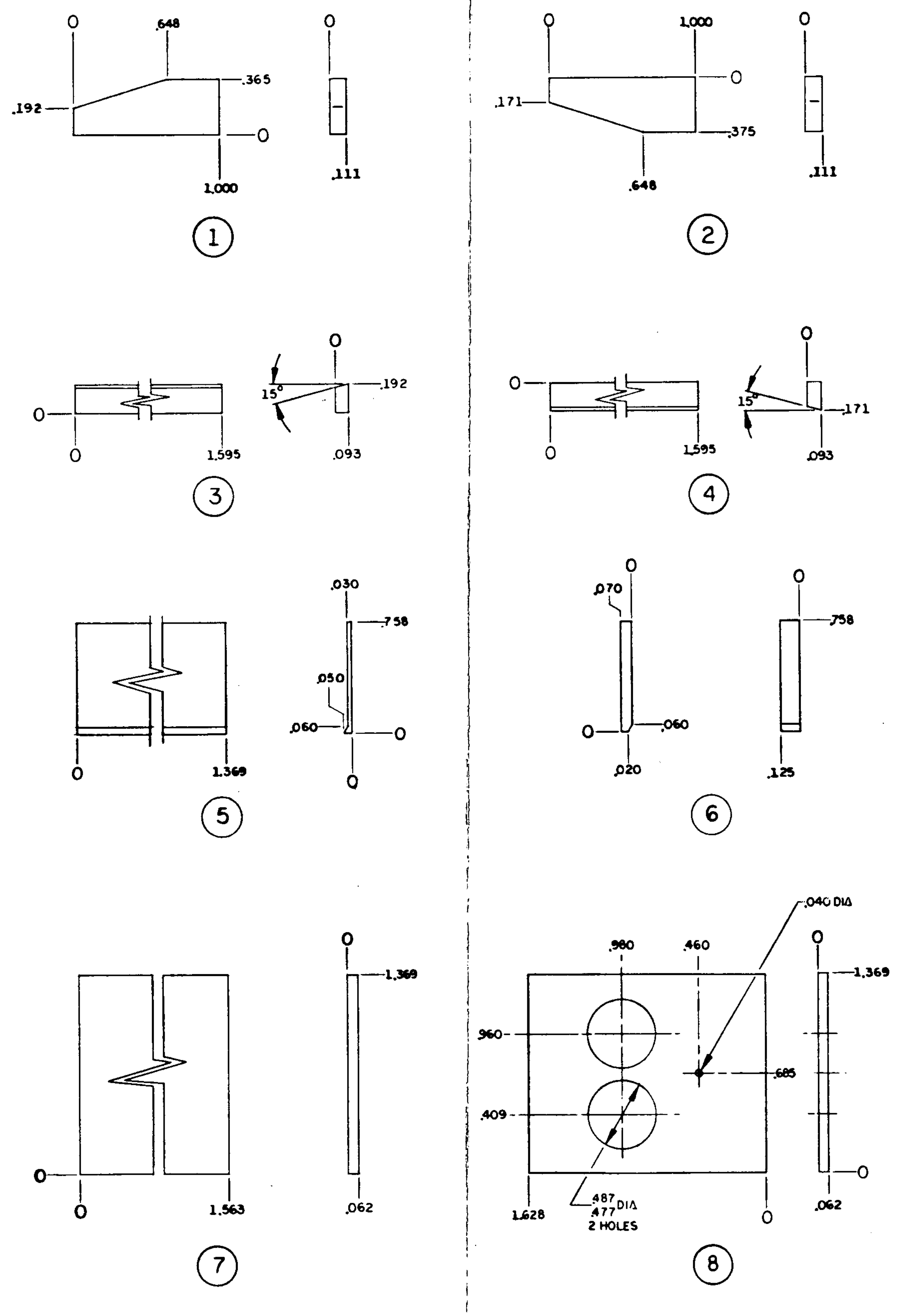


Figure 18. Mykroy Insulator

QUANTITY REQD				SYM	VENDOR DATA PER.	CODE IDENT	PART OR IDENTIFYING NO.	ZONE	NOMENCLATURE OR DESCRIPTION	DIA	THICK	WIDTH	LENGTH	MATERIAL	MATL SPECIFICATION	TS 1000 PSI	UNIT WT
				8			-8		INSULATOR		.062	1.5	1.7				
				7			-7				.062	1.5	1.6				
				6			-6				.070	.135	0.8	MYKROY GRADE 1100			
				5			-5				.050	0.8	1.5	MOLECULAR DIELECTRICS, INC.			
				4			-4				.093	.180	1.6	CLIFTON, NEW JERSEY			
				3			-3				.093	.200	1.6				
				2			-2				.125	.38	1.1				
				1			PC145D1034-1		INSULATOR		.125	.38	1.1				

STOCK SIZE

LIST OF MATERIAL

PART NUMBER MARKING PER MIL-STD-130

NEXT ASSEMBLY	USED ON	NEXT ASSY	FINAL ASSY
PC145D1035	SMS MICROTHRUSTER		2 OF 2 1 OF 4 & 8
PC145D1031	" " "		1 OF 3,5 & 7
PC145D1031	SMS MICROTHRUSTER		2 OF 1 & 6
APPLICATION		QUANTITY REQD	

DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED

DEC TOL	SH MET. RAD
2 PLACE ±	BEND:
3 PLACE ±.002	COR:
ANGULAR ±	DEBURR ALL EDGES

APPLICABLE SPECIFICATIONS

FINISH: NONE

HEAT TREAT:

BEND RELIEF:

FOR ADDL SPEC SEE NOTE

DO NOT SCALE DRAWING

DRAWN

CHECKED

GR ENGR

STRUCT

WEIGHTS

PROJ ENGR

CONTRACT NO. NAS-5-11494

FAIRCHILD HILLER
REPUBLIC AVIATION DIVISION

INSULATORS
POSITIVE & NEGATIVE ELECTRODE
SMS MICROTHRUSTER

SIZE	CODE IDENT NO		REV.
D	77751	PC145D1034	

SCALE: TWICE

SHEET

FORM RAD 142A

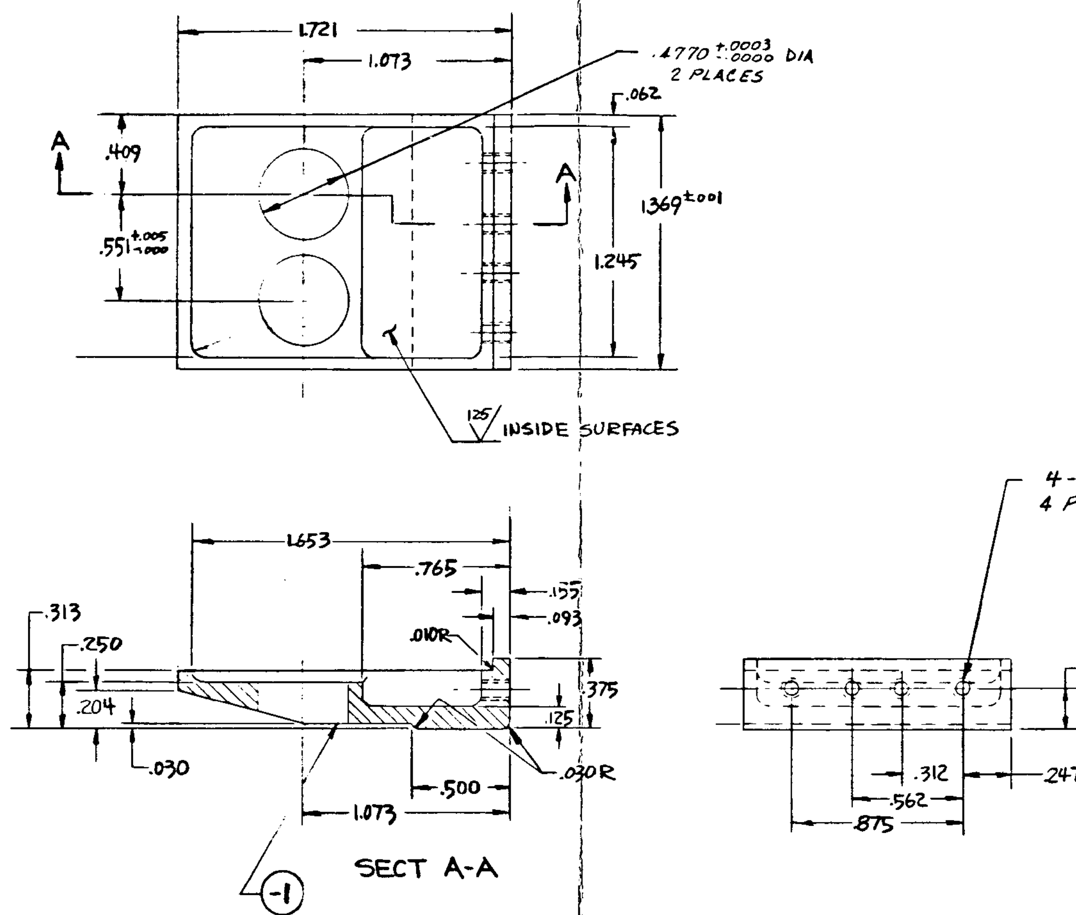
FOLDOUT FRAME 1

FOLDOUT FRAME 2

PC145D1036

TYPE OF CHANGE	EAI INC	REWORK PERMIT YES	REWORK PERMIT NO	SYM	DESCRIPTION	DATE	APPROVED

REVISIONS



REQUIREMENTS FOR MACHINED PARTS
(UNLESS OTHERWISE SPECIFIED)

(A) MAX. RHR OF MACHINED SURFACES (EXCLUDING HOLES) 63 ALL OVER
(B) MAX. RHR OF HOLES 32
(C) ALL FILLETS .060 R ± .010
(D) ALL EDGES TO BE ROUNDED .010 MAX. (WHEN ROUNDING IS NOT SPECIFIED ON DWG.)
(E) TOLERANCES TO APPLY AFTER WELDING, HEAT TREATING, OR PLATING OPERATIONS. INITIAL DIMENSIONS OF SURFACES TO BE CADMIUM PLATED SHALL NOT BE LESS THAN THE MINIMUM INDICATED FINISHED DIMENSIONS.
(F) APPLY PART NUMBER & INSPECTOR'S STAMP

Figure 19. Electrode Negative

LIST OF MATERIAL

QUANTITY REQD	SYM	VENDOR DATA PER	CODE IDENT	PART OR IDENTIFYING NO.	ZONE	NOMENCLATURE OR DESCRIPTION	DIA	THICK	WIDTH	LENGTH	MATERIAL	MATL SPECIFICATION	TS 1000 PSI	UNIT WT
				PC145D1036-1		ELECTRODE	.375	1.5	2.0		17-7 PH STAINLESS STEEL	MIL-S-25043, COND A		

PART NUMBER MARKING PER MIL-STD-130

UNAUTHORIZED USE, MANUFACTURE OR REPRODUCTION IN WHOLE OR IN PART IS PROHIBITED. DRAWING, DESIGN AND OTHER DISCLOSURES PROPERTY OF FAIRCHILD HILLER CORPORATION.

NEXT ASSEMBLY	USED ON	NEXT ASSY	FINAL ASSY
PC145D1035	SMS MICROTHRUSTER		1 OF -1

APPLICATION | QUANTITY REQD

DIMENSIONS ARE IN INCHES
UNLESS OTHERWISE NOTED
DEC TOL | SH MET. RAD
2 PLACE ± .02 | BEND:
3 PLACE ± .002 | COR:
ANGULAR ± | DEBURR ALL EDGES
APPLICABLE SPECIFICATIONS
FINISH:
HEAT TREAT:
BEND RELIEF:
FOR ADDL SPEC SEE NOTE
DO NOT SCALE DRAWING

DRAWN
CHECKED
GR ENGR
STRUCT
WEIGHTS
PROJ ENGR
CONTRACT NO. NAS-5-11494

FAIRCHILD HILLER
REPUBLIC AVIATION DIVISION
FARMINGDALE, LONG ISLAND, NEW YORK

ELECTRODE - NEGATIVE SMS MICROTHRUSTER

SIZE C | CODE IDENT NO. 77751 | PC145D1036

SCALE 2/1 | UNLESS OTHERWISE NOTED | SHEET

FORM RAD 141

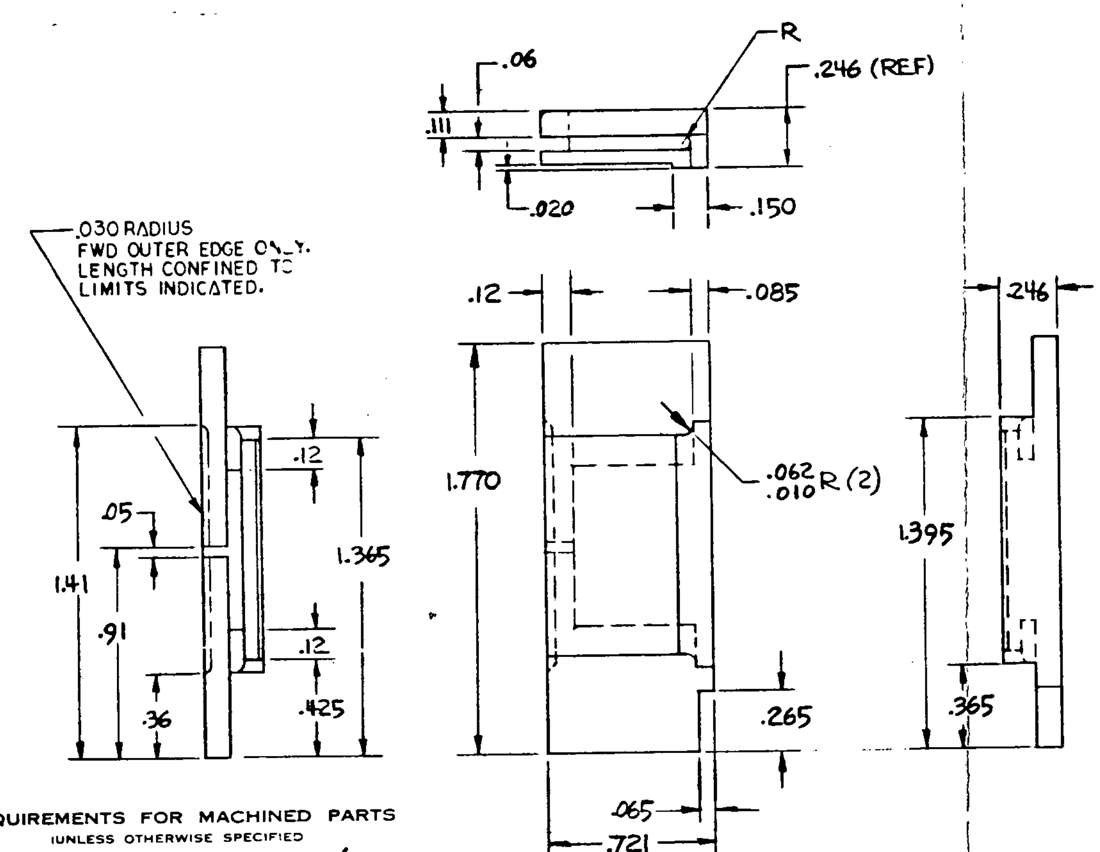
C-20

FOLDOUT FRAME 1

FOLDOUT FRAME 2

PC145D1037

TYPE OF CHANGE	EAI INC		SYM	REVISIONS DESCRIPTION	DATE	APPROVED



REQUIREMENTS FOR MACHINED PARTS
UNLESS OTHERWISE SPECIFIED

(A) MAX. RHR OF MACHINED SURFACES (EXCLUDING HOLES) 32√ ALL OVER
(B) MAX. RHR OF HOLES √
(C) ALL FILLETS .010 R ± .005
(D) ALL EDGES TO BE ROUNDED .010 MAX. (WHEN ROUNDING IS NOT SPECIFIED ON DWG.)
(E) TOLERANCES TO APPLY AFTER WELDING, HEAT TREATING, OR PLATING OPERATIONS. INITIAL DIMENSIONS OF SURFACES TO BE CADMIUM PLATED, SHALL NOT BE LESS THAN THE MINIMUM INDICATED FINISHED DIMENSIONS.
(F) APPLY PART NUMBER & INSPECTOR'S STAMP PER STD PROCEDURES FOR SMALL PARTS.

1 SHOWN
2 OPPOSITE

Figure 20. Insulator, Mykroy Sides

QUANTITY REQD				SYM	VENDOR DATA PER	CODE IDENT	PART OR IDENTIFYING NO.	ZONE	NOMENCLATURE OR DESCRIPTION	DIA	THICK	WIDTH	LENGTH	MATERIAL	MATL SPECIFICATION	TS 1000 PSI	UNIT WT
				2			-2		INSULATOR		.250	.8	1.8	MYKROY GRADE 1100			
				1			PC145D1037-1		INSULATOR		.250	.8	1.8	MOLECULAR DIELECTRICS INC., CLIFTON, N.J.			

LIST OF MATERIAL

PART NUMBER MARKING PER MIL-STD-130

UNAUTHORIZED USE, MANUFACTURE OR REPRODUCTION IN WHOLE OR IN PART IS PROHIBITED. DRAWING, DESIGN AND OTHER DISCLOSURES PROPERTY OF FAIRCHILD HILLER CORPORATION.

NEXT ASSEMBLY	USED ON	NEXT ASSY	FINAL ASSY
PC145D1030	SMS MICROTHRUSTER		1 OF-1 1 OF-2

APPLICATION — QUANTITY REQD

DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED
DEC TOL — RAD
2 PLACE ±.01 — BEND:
3 PLACE ±.002 — COR:
ANGULAR ± — DEBURR ALL EDGES
APPLICABLE SPECIFICATIONS
FINISH:
HEAT TREAT:
BEND RELIEF:
FOR ADDL SPEC SEE NOTE
DO NOT SCALE DRAWING

DRAWN
CHECKED J. CHUNG 4-18-72
GR ENGR
STRUCT
WEIGHTS
PROJ ENGR
CONTRACT NO. NAS-5-11494

FAIRCHILD HILLER
REPUBLIC AVIATION DIVISION
FARMINGDALE, LONG ISLAND, NEW YORK

INSULATOR-FUEL
SMS-MICROTHRUSTER

SIZE C — CODE IDENT NO. 77751 — PC145D1037 — REV.
SCALE TWICE UNLESS OTHERWISE NOTED — SHEET

PC145D1037

FORM RAD 141

C-22

FOLDOUT FRAME 1

FOLDOUT FRAME 2

REQUIREMENTS FOR MACHINED PARTS
(UNLESS OTHERWISE SPECIFIED)

(A) MAX. RHR OF MACHINED SURFACES (EXCLUDING HOLES) 63 ALL OVER
(B) MAX. RHR OF HOLES ✓
(C) ALL FILLETS .010 R ± .005
(D) ALL EDGES TO BE ROUNDED .01 MAX. (WHEN ROUNDING IS NOT SPECIFIED ON DWG.)
(E) TOLERANCES TO APPLY AFTER WELDING, HEAT TREATING, OR PLATING OPERATIONS. INITIAL DIMENSIONS OF SURFACES TO BE CADMIUM PLATED, SHALL NOT BE LESS THAN THE MINIMUM INDICATED FINISHED DIMENSIONS.
(F) APPLY PART NUMBER & INSPECTOR'S STAMP BY TAG.

TYPE OF CHANGE	EAI INC	REWORK PERMIT YES NO	ZONE	LTR	REVISIONS DESCRIPTION	DATE	APPROVED

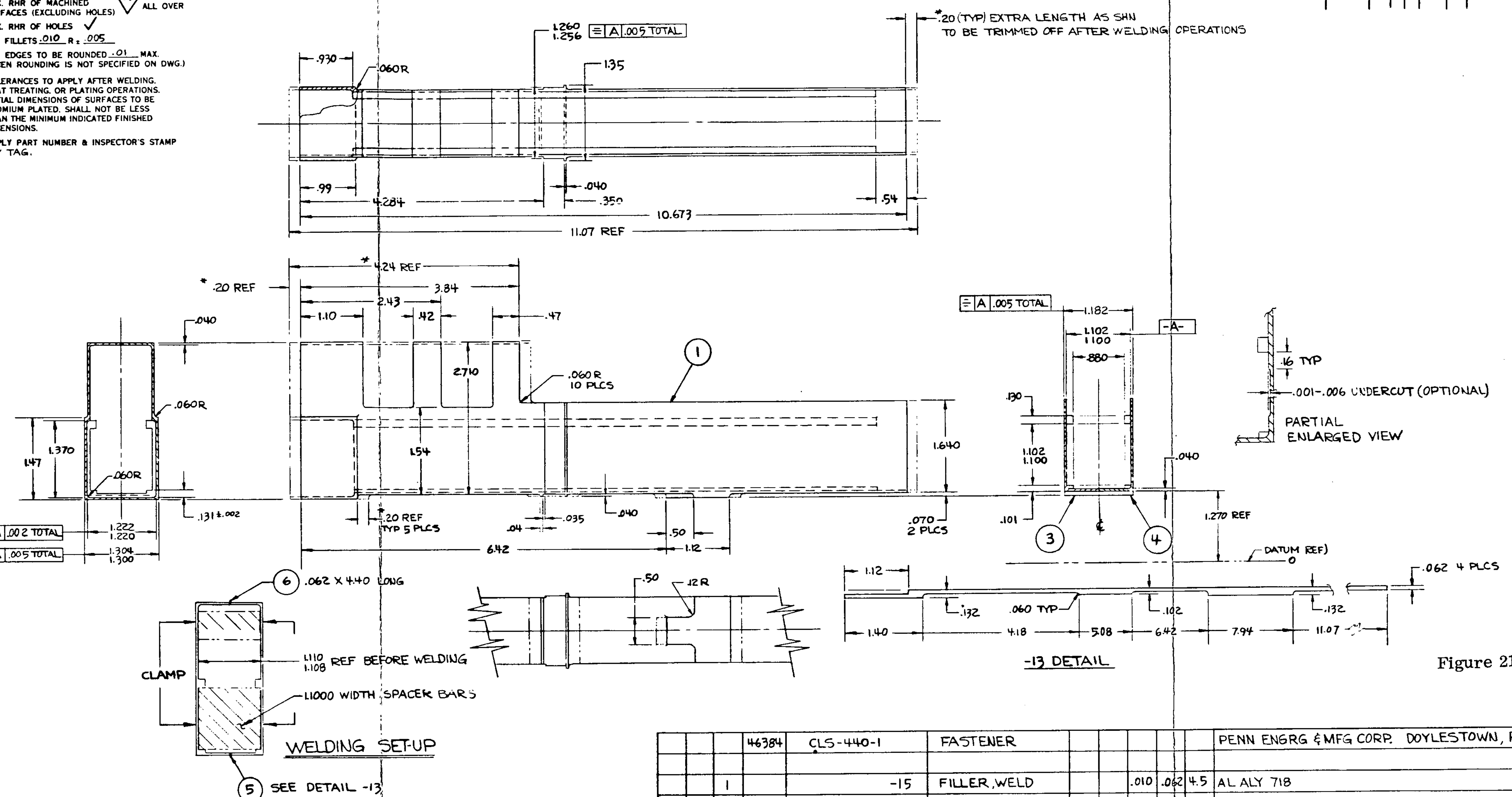


Figure 21. Beam Assembly, Covers, End Closure

NOTES

* 1. MATERIAL REQD FOR SOUND WELD AT SEAM; TO BE MACHINED OFF AFTER WELDING.
2. ELECTRON BEAM WELD PER MIL-W-46132

QUANTITY REQD	CODE IDENT	PART NO. OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	ZONE	DIA	THICK	WIDTH	LENGTH	MATERIAL / MATERIAL SPECIFICATION / CONDITION VENDOR NAME AND ADDRESS	PROCESS SPECIFICATION LINE NUMBERS	FINISH CODE	MARK CODE	FIELD NOTES	TRACE CODE	LINE NO.
	46384	CLS-440-1	FASTENER						PENN ENGRG & MFG CORP. DOYLESTOWN, PA						8
															7
1		-15	FILLER, WELD			.010	.062	4.5	AL ALY 718						6
1		-13	FILLER, WELD			.010	.20	11.2	AL ALY 718						5
1		-12	BEAM (OPP)			.75	3.00	11.2	AL ALY 6061-T651 PL QQ-A-250/11				1		4
1		-11	BEAM			.75	3.00	11.2	AL ALY 6061-T651 PL QQ-A-250/11				1		3
															2
		PC145D1040 -1	BEAM ASSEMBLY										1		1
-1		←	ASSEMBLIES												

LIST OF MATERIAL

PART NUMBER MARKING PER MIL-STD-130

NEXT ASSEMBLY	USED ON	NEXT ASSY	FINAL ASSY
PC145D1005	SMS MICROTHRUSTER		1 OF 1

APPLICATION | QUANTITY REQD

WEIGHTS
TOTAL WEIGHTS
DASH NO.
WEIGHT

DO NOT SCALE DRAWING
ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED.
TOLERANCES UNLESS NOTED
XX±.01 XXX±.005 ANG±

LAYOUT BY
DRAWN BY J. CHUNG 4-12-72
CHECKED
ENGINEER
STRUCTURES
APPROVED
CONTRACT NO. NAS-5-11494

FAIRCHILD HILLER
FAIRCHILD REPUBLIC DIVISION
FARMINGDALE, NEW YORK 11735

BEAM ASSEMBLY-
SMS MICROTHRUSTER

SIZE D | CODE IDENT NO. 77751 | PC145D1040
SCALE FULL | SHEET 1 OF

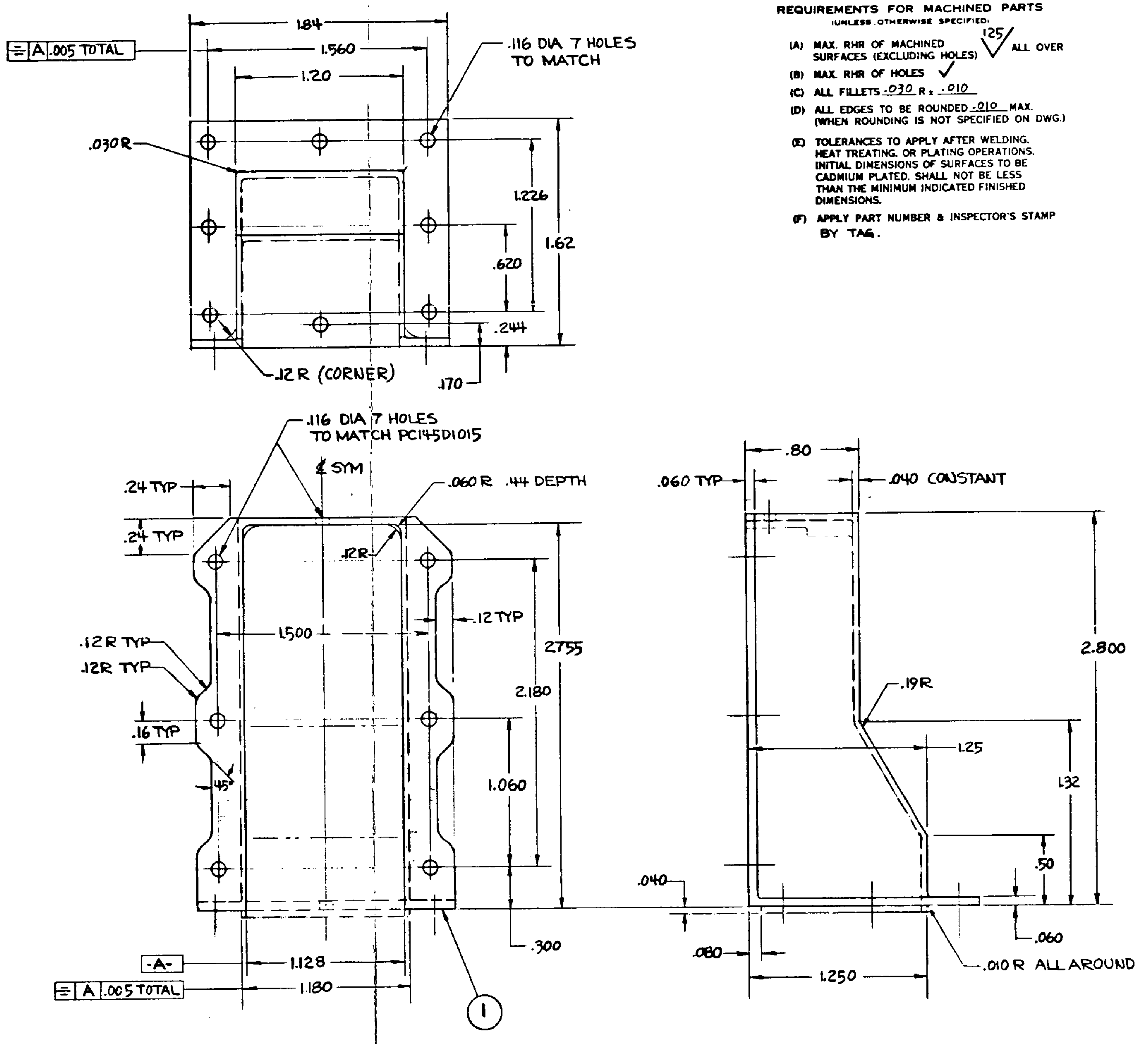
FR-8-12 DC

C-24 C-24.1 C-25

FOLDOUT FRAME 1

FOLDOUT FRAME 2

REVISIONS								
TYPE OF CHANGE	EAI INC	REWORK PERMIT YES NO		ZONE	LTR	DESCRIPTION	DATE	APPROVED



REQUIREMENTS FOR MACHINED PARTS
(UNLESS OTHERWISE SPECIFIED)

(A) MAX. RHR OF MACHINED SURFACES (EXCLUDING HOLES) 125✓ ALL OVER

(B) MAX. RHR OF HOLES ✓

(C) ALL FILLETS .030 R ± .010

(D) ALL EDGES TO BE ROUNDED .010 MAX. (WHEN ROUNDING IS NOT SPECIFIED ON DWG.)

(E) TOLERANCES TO APPLY AFTER WELDING. HEAT TREATING. OR PLATING OPERATIONS. INITIAL DIMENSIONS OF SURFACES TO BE CADMIUM PLATED, SHALL NOT BE LESS THAN THE MINIMUM INDICATED FINISHED DIMENSIONS.

(F) APPLY PART NUMBER & INSPECTOR'S STAMP BY TAG.

Figure 22. Electrical Interface Cover

PC145D1043

																4
																3
																2
		PC145D1043-1	COVER			1.75	2.00	3.0	AL AL 60? -T? PL QQ-A-250/11							1
QUANTITY REQD	CODE IDENT	PART NO. OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	ZONE	DIA	THICK	WIDTH	LENGTH	MATERIAL MATERIAL SPECIFICATION / CONDITION VENDOR NAME AND ADDRESS	PROCESS SPECIFICATION LINE NUMBERS	FINISH CODE	MARK CODE	FIELD NOTES	TRACE CODE		LINE NO.
					STOCK SIZE											

LIST OF MATERIAL

PART NUMBER MARKING PER MIL-STD-130

UNAUTHORIZED USE MANUFACTURE OR REPRODUCTION IN WHOLE OR IN PART IS PROHIBITED. DRAWING, DESIGN AND OTHER DISCLOSURES PROPERTY OF FAIRCHILD HILLER CORPORATION

PC145D1005	SMS MICROTHRUSTER	1 OF -1	1 OF -1
NEXT ASSEMBLY	USED ON	NEXT ASSY	FINAL ASSY
APPLICATION		QUANTITY REQD	

WEIGHTS
TOTAL WEIGHTS
DASH NO.
WEIGHT

DO NOT SCALE DRAWING
ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED.
TOLERANCES UNLESS NOTED XX± .010 XXX± ... ANGLE 1°

LAYOUT BY	
DRAWN BY	J CHUNG 5-3-72
CHECKED	
ENGINEER	
STRUCTURES	
APPROVED	
CONTRACT NO.	NAS-5-11494

FAIRCHILD HILLER
FAIRCHILD REPUBLIC DIVISION
FARMINGDALE, NEW YORK 11735

COVER —
ELECTRICAL SHIELDING
SMS MICROTHRUSTER

SIZE	CODE IDENT NO.	
D	77751	PC145D1043
SCALE		SHEET 1 OF

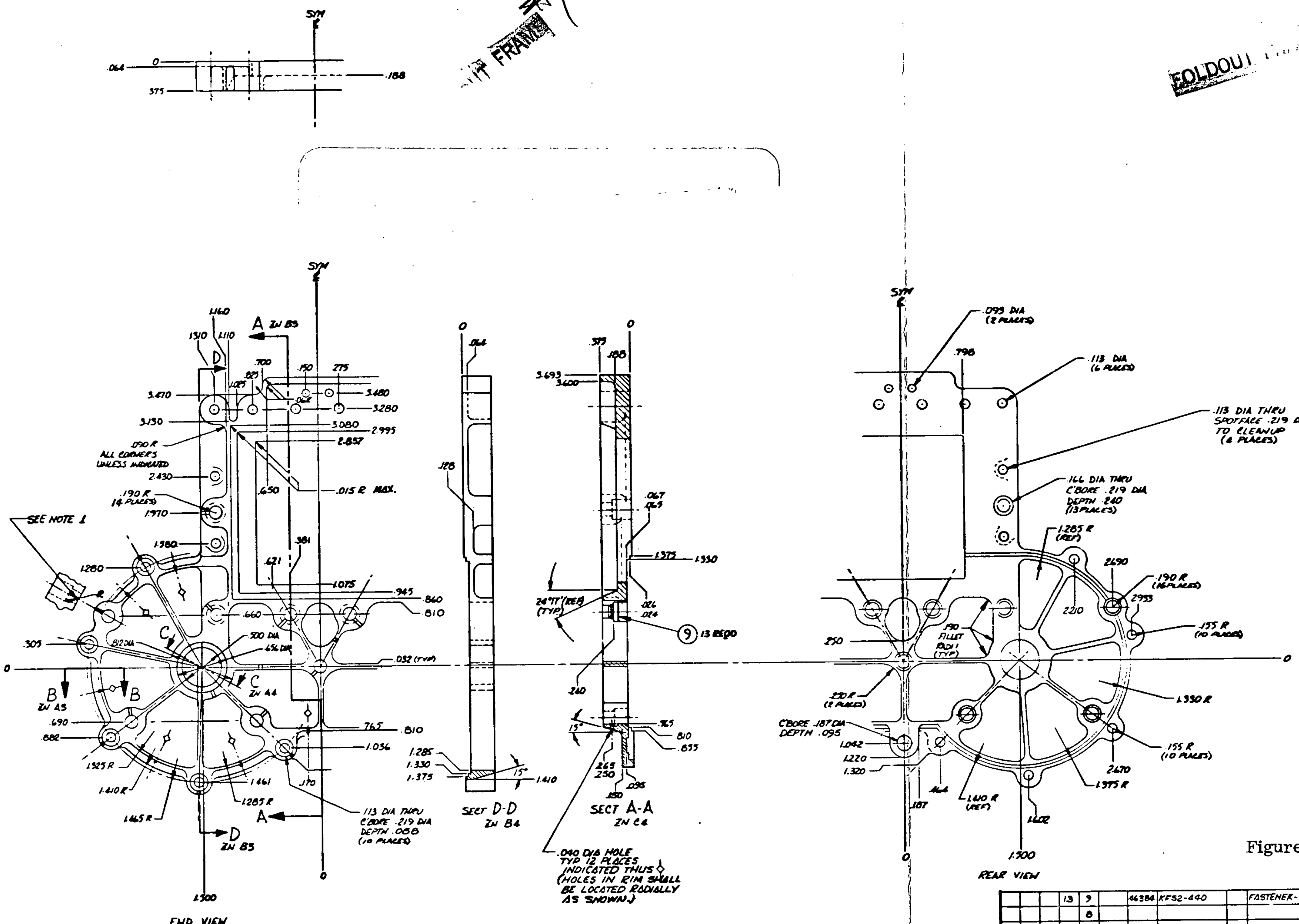
FR-S-12 DC

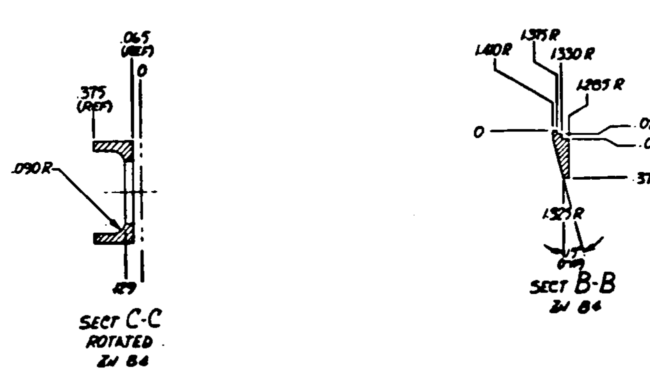
c.26

c.27

FOLDOUT FRAME 1

FOLDOUT FRAME 2





NOTE:

1. NOTCH .040 WIDE × .040 DEEP POSITIONED APPROXIMATELY AS SHOW ~ TYPICAL 28 PLACES ~
2. BREAK SHARP EDGES ON REAR SIDE TO .010 R MAX.

Figure 23. Forward Faceplate Assembly

QUANTITY REQD				SYM	VENDOR CATA PER	CODE IDENT	PART OR IDENTIFYING NO.	ZONE	NOMENCLATURE OR DESCRIPTION	DIA	THICK	WIDTH	LENGTH	MATERIAL	MATL SPECIFICATION	TS	UNIT WT
			13	9		46384	KFS2-440		FASTENER-BROACHING TYPE					PENN ENGG & MFG CO., DOYLESTOWN	PENNA 18901		
				8													
				7													
				6													
			1	5			-5		FACE PLATE-DETAIL		.375	6.0	8.0	FIBRE GLASS SH., NEMA G-10			
				4													
				3													
				2													
				1			PC145D1050-1		FACE PLATE ASY								
			-1														

LIST OF MATERIAL

PART NUMBER MARKING PER MIL-STD-130

UNAUTHORIZED USE, MANUFACTURE OR REPRODUCTION IN WHOLE OR IN PART IS PROHIBITED. DRAWING, DESIGN AND OTHER DISCLOSURES PROPERTY OF FAIRCHILD HILLER CORPORATION.

DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED

DEC TOL: 2 PLACE ±.02; 3 PLACE ±.005; ANGULAR ±

SH MET RAD: BEND; COP; DEBURR ALL EDGES

DRAWN / CHECKED / GR ENGR / STRUCT / WEIGHTS / PROJ ENGR

APPLICABLE SPECIFICATIONS

FINISH: NONE

HEAT TREAT:

BEND RELIEF:

FOR ADDL SPEC SEE NOTE

CONTRACT NO. NAS-5-11494

DO NOT SCALE DRAWING

NEXT ASSEMBLY	USED ON	NEXT ASSY	FINAL ASSY
PC145D1030	SMS MICROTHRUSTER		1 of 1

APPLICATION — QUANTITY REQD

FAIRCHILD HILLER
REPUBLIC AVIATION DIVISION

FACE PLATE-ASY
SMS-MICROTHRUSTER

SIZE E — CODE IDENT NO. 77751 — PC145D1050

SCALE TWICE — SHEET

C-28

C-29

FOLDOUT FRAME 1

FOLDOUT FRAME 2

TYPE OF CHANGE	EAI INC	REWORK PERMIT YES	REWORK PERMIT NO	ZONE	LTR	REVISIONS DESCRIPTION	DATE	APPROVED

PC145D1051

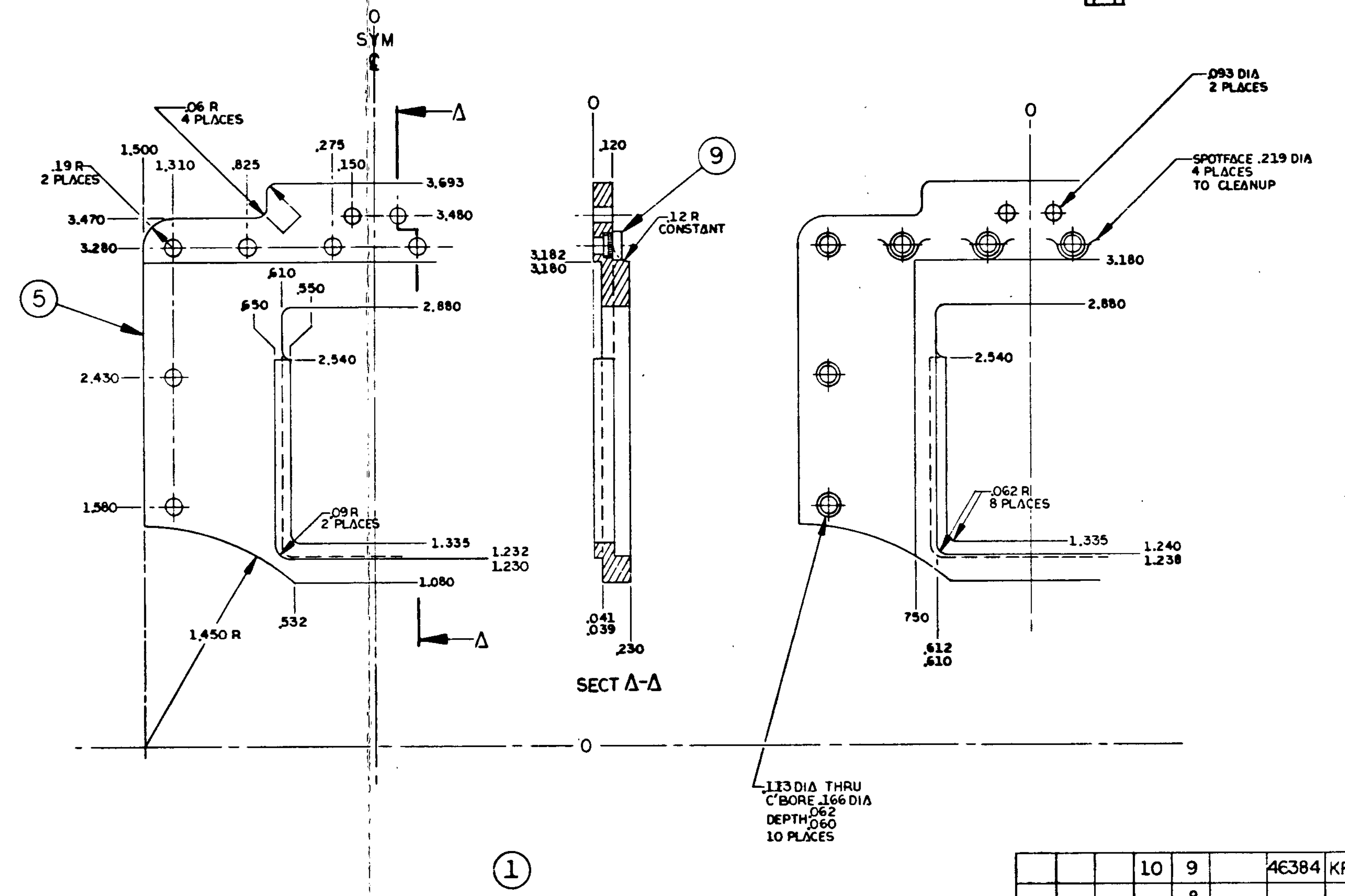


Figure 24. Rear Faceplate Assembly

QUANTITY REQD				SYM	VENDOR DATA PER.	CODE IDENT	PART OR IDENTIFYING NO	ZONE	NOMENCLATURE OR DESCRIPTION	DIA	THICK	WIDTH	LENGTH	MATERIAL	MATL SPECIFICATION	TS 1000 PSI	UNIT WT
			10	9		46384	KFS2-440		FASTENER-BROACHING TYPE					PENN ENG'G & MFG.CO.,DOYLESTOWN,PENNA. 18901			
				8													
				7													
				6													
			1	5			-5		FACEPLATE-DETAIL		.250	3.2	3.9	FIBRE GLASS SH NEMA G10			
				4													
				3													
				2													
				1			PC145D1051-1		FACEPLATE ASY—REAR								

STOCK SIZE

LIST OF MATERIAL

PART NUMBER MARKING PER MIL-STD-130

NEXT ASSEMBLY	USED ON	NEXT ASSY	FINAL ASSY
PC145D1051	SMS MICROTHRUSTER		1 OF 1

APPLICATION — QUANTITY REQD

DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED

DEC TOL	SH MET. RAD
2 PLACE ±.02	BEND:
3 PLACE ±.005	COR:
ANGULAR±	DEBURR ALL EDGES

APPLICABLE SPECIFICATIONS
FINISH: NONE
HEAT TREAT:
BEND RELIEF:
FOR ADDL SPEC SEE NOTE

DO NOT SCALE DRAWING

DRAWN GLS
CHECKED
GR ENGR
STRUCT
WEIGHTS
PROJ ENGR
CONTRACT NO. NAS-5-11494

FAIRCHILD HILLER
REPUBLIC AVIATION DIVISION
FARMINGDALE, 11735 NEW YORK

FACEPLATE ASY-REAR
SMS MICROTHRUSTER

SIZE	CODE IDENT NO.		REV
D	77751	PC145D1051	

SCALE TWICE SHEET

FORM RAD 142A

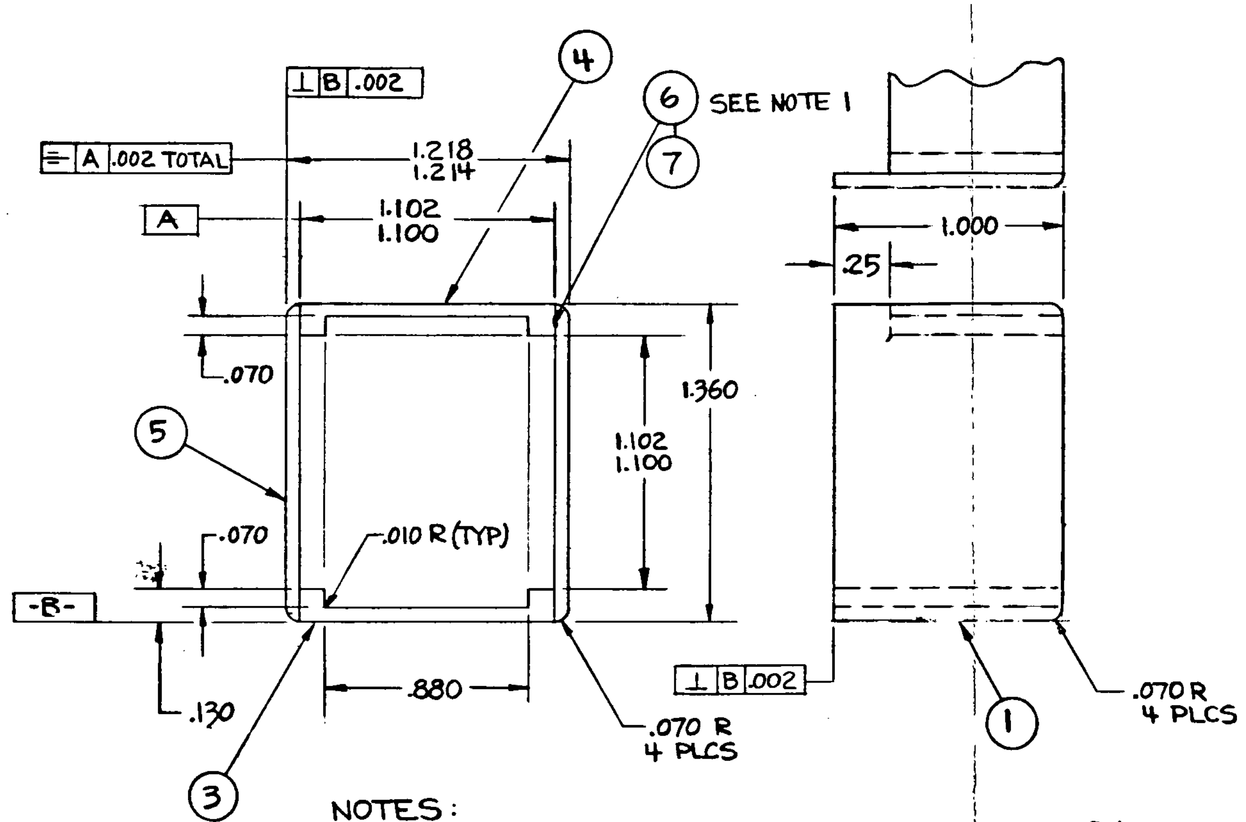
PC145D1051

FOLDOUT FRAME 1

FOLDOUT FRAME 2

PC145D1052

REVISIONS							
TYPE OF CHANGE	EAI INC	REWORK PERMIT YES	REWORK PERMIT NO	SYM	DESCRIPTION	DATE	APPROVED



NOTES:
1. MIX EPON 828 AND VERSAMID 140 IN 5/50 PROPORTIONS BY WEIGHT. CURE AT 65°C (150°F) FOR 24 HOURS

Figure 25. Shield

PC145D1052

QUANTITY REQD				SYM	VENDOR DATA PER	CODE IDENT	PART OR IDENTIFYING NO.	ZONE	NOMENCLATURE OR DESCRIPTION	DIA	THICK	WIDTH	LENGTH	MATERIAL	MATL SPECIFICATION	TS 1000 PSI	UNIT WT
			✓	7	11884		VERSAMID 140		HARDENER					GENERAL MILLS CHEMICAL DIV. KANKAKEE ILL.			
			✓	6	13598		EPON 828		RESIN					MILLER STEPHENSON CHEMICAL CO DANBURY CONN.			
			2	5			-15		PLATE		.062	1.1	1.5	FIBRE GLASS SH NEMA G10			
			1	4			-13		CHANNEL		.156	1.1	1.2	FIBRE GLASS SH NEMA G10			
			1	3			-11		CHANNEL		.156	1.2	1.2	FIBRE GLASS SH NEMA G10			
				2													
				1			PC145D1052-1		SHIELD ASSY								
									ASSEMBLIES								

LIST OF MATERIAL

PART NUMBER MARKING PER MIL-STD-130

UNAUTHORIZED USE, MANUFACTURE OR REPRODUCTION IN WHOLE OR IN PART IS PROHIBITED. DRAWING, DESIGN AND OTHER DISCLOSURES PROPERTY OF FAIRCHILD HILLER CORPORATION.

NEXT ASSEMBLY	USED ON	NEXT ASSY	FINAL ASSY
PC145D1051	SMS MICROTHRUSTER		1 OF -1

APPLICATION — QUANTITY REQD

DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED

DEC TOL	SH MET. RAD
2 PLACE ±.010	BEND:
3 PLACE ±.005	COR:
ANGULAR ±	DEBURR ALL EDGES

APPLICABLE SPECIFICATIONS

FINISH:

HEAT TREAT:

BEND RELIEF:

FOR ADDL SPEC SEE NOTE

DO NOT SCALE DRAWING

DRAWN	J. CHUNG	4-17-72
CHECKED		
GR ENGR		
STRUCT		
WEIGHTS		
PROJ ENGR		

CONTRACT NO. NAS-5-11494

FAIRCHILD HILLER
REPUBLIC AVIATION DIVISION
FARMINGDALE, LONG ISLAND, NEW YORK

SHIELD ASSY – REAR FACEPLATE SMS MICROTHRUSTER

SIZE	CODE IDENT NO.	
C	77751	PC145D1052

SCALE 2/1 UNLESS OTHERWISE NOTED SHEET

FORM RAD 141

C-32

FOLDOUT FRAME 1

FOLDOUT FRAME 2

REQUIREMENTS FOR MACH'NED PARTS
(UNLESS OTHERWISE SPECIFIED)

(A) MAX. RHR OF MACHINED SURFACES (EXCLUDING HOLES) 63 ALL OVER
(B) MAX. RHR OF HOLES
(C) ALL FILLETS .040 R ± .010
(D) ALL EDGES TO BE ROUNDED .010 MAX. (WHEN ROUNDING IS NOT SPECIFIED ON DWG.)
(E) TOLERANCES TO APPLY AFTER WELDING. HEAT TREATING, OR PLATING OPERATIONS. INITIAL DIMENSIONS OF SURFACES TO BE CADMIUM PLATED, SHALL NOT BE LESS THAN THE MINIMUM INDICATED FINISHED DIMENSIONS.
(F) APPLY PART NUMBER & INSPECTOR'S STAMP BY TAG.

TYPE OF CHANGE	EAI INC	REWORK PERMIT YES NO	ZONE	LTR	REVISIONS DESCRIPTION	DATE	APPROVED

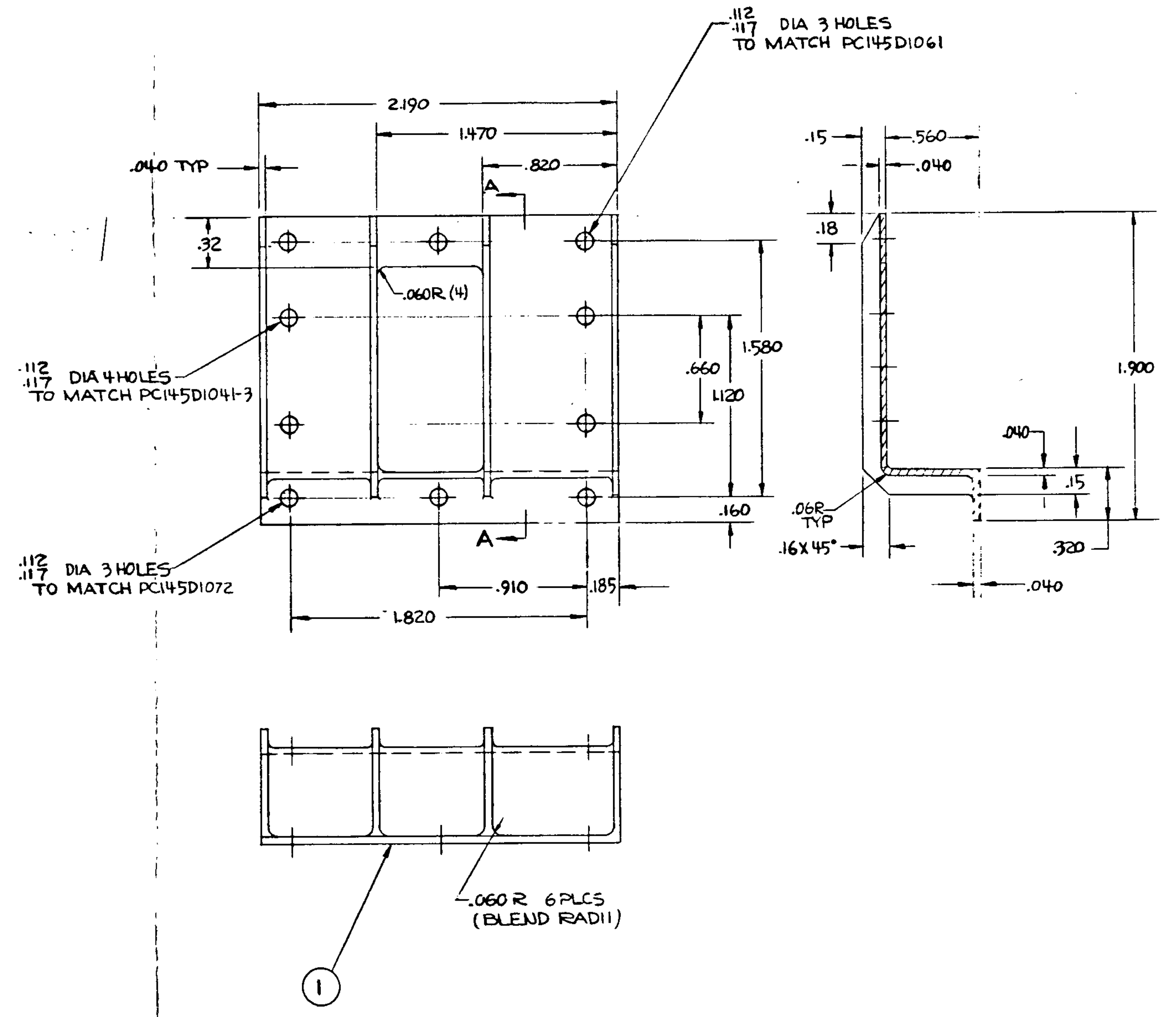


Figure 26. Bridge

PC145D1063

QUANTITY REQD				CODE IDENT	PART NO. OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	ZONE	STOCK SIZE DIA	THICK	WIDTH	LENGTH	MATERIAL / MATERIAL SPECIFICATION / CONDITION VENDOR NAME AND ADDRESS	PROCESS SPECIFICATION LINE NUMBERS	FINISH CODE	MARK CODE	FIELD NOTES	TRACE CODE	LINE NO.
																		3
																		2
					PC145D1063-1	BRIDGE			.750	2.0	2.3	AL ALY 6061-T6 PL QQ-A-250/11						1

LIST OF MATERIAL

PART NUMBER MARKING PER MIL-STD-130

NEXT ASSEMBLY	USED ON	NEXT ASSY	FINAL ASSY
PC145D1065	SMS MICROTHRUSTER	1 OF -1	1 OF -1
APPLICATION		QUANTITY REQD	

WEIGHTS
TOTAL WEIGHTS
DASH NO.
WEIGHT

DO NOT SCALE DRAWING
ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED.
TOLERANCES UNLESS NOTED
XX±.01 XXX±.005 ANG±

UNAUTHORIZED USE, MANUFACTURE OR REPRODUCTION IN WHOLE OR IN PART IS PROHIBITED. DRAWING, DESIGN AND OTHER DISCLOSURES PROPERTY OF FAIRCHILD HILLER CORPORATION

LAYOUT BY
DRAWN BY J. CHUNG 4-18-72
CHECKED
ENGINEER
STRUCTURES
APPROVED
CONTRACT NO. NAS-5-11494

FAIRCHILD HILLER
FAIRCHILD REPUBLIC DIVISION
FARMINGDALE, NEW YORK 11735

BRIDGE—
ELECTRONICS ASSY
SMS MICROTHRUSTER

SIZE	CODE IDENT NO.	
D	77751	PC145D1063

SCALE
SHEET 1 OF

FR-S-12 DC

C-34

C-35

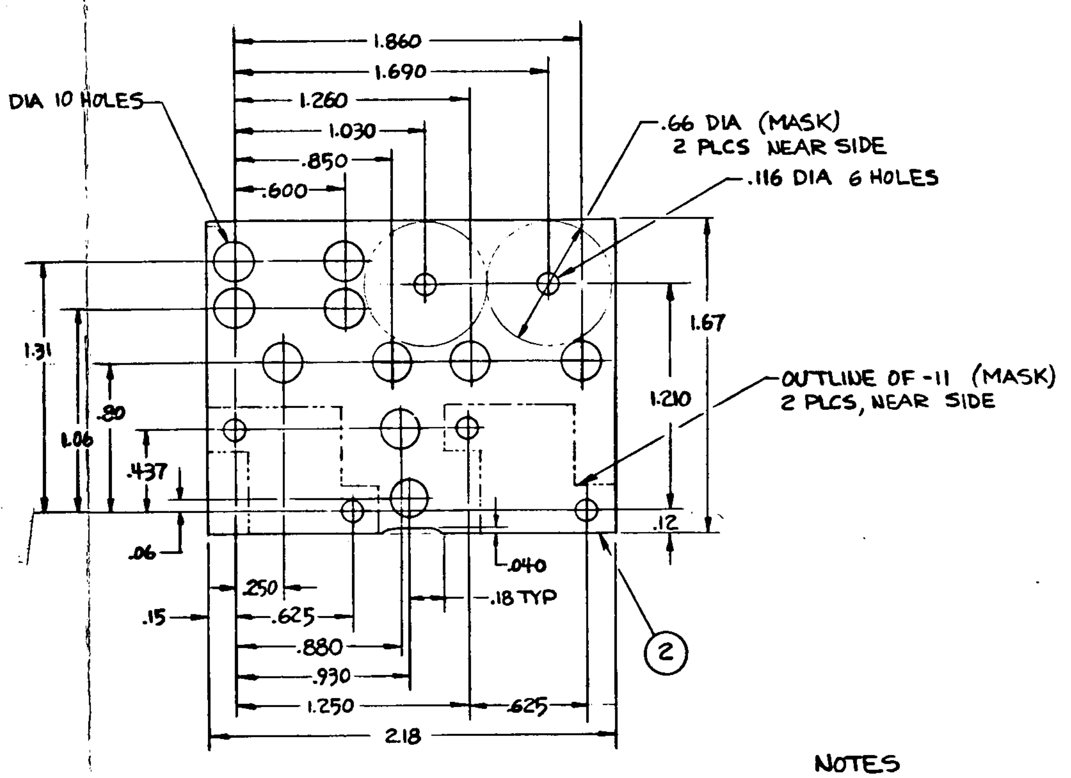
FOLDOUT FRAME 1

FOLDOUT FRAME 2

REQUIREMENTS FOR MACHINED PARTS
(UNLESS OTHERWISE SPECIFIED)

(A) MAX. RHR OF MACHINED SURFACES (EXCLUDING HOLES) 125 ALL OVER
(B) MAX. RHR OF HOLES ✓
(C) ALL FILLETS .090 R ± .010
(D) ALL EDGES TO BE ROUNDED ____ MAX. (WHEN ROUNDING IS NOT SPECIFIED ON DWG.)
(E) TOLERANCES TO APPLY AFTER WELDING, HEAT TREATING, OR PLATING OPERATIONS. INITIAL DIMENSIONS OF SURFACES TO BE CADMIUM PLATED, SHALL NOT BE LESS THAN THE MINIMUM INDICATED FINISHED DIMENSIONS.
(F) APPLY PART NUMBER & INSPECTOR'S STAMP BY TAG.

TYPE OF CHANGE	EAI INC	REWORK PERMIT YES NO	ZONE	LTR	REVISIONS DESCRIPTION	DATE	APPROVED



NOTES
1. SAND BLAST BOTH SIDES VERY GENTLY EXCEPT IN DESIGNATED MASKED AREAS
2. -11 BASE PLATE TO BE ATTACHED TO PTE-5904E TRANSFORMER DURING FABRICATION OF TRANSFORMER

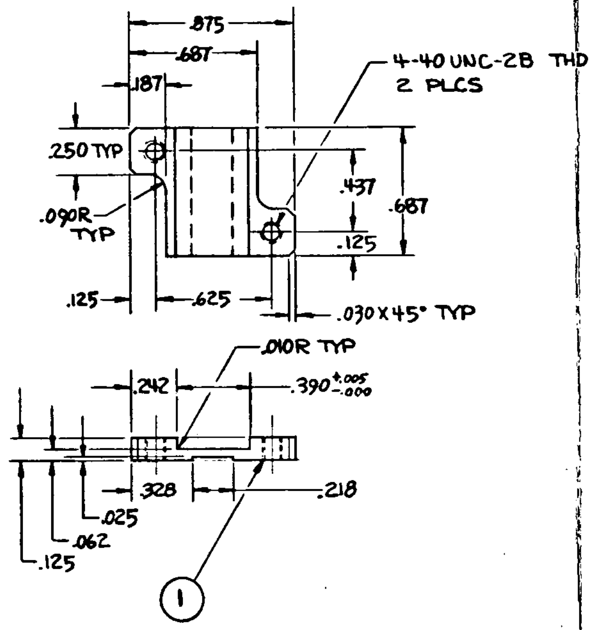


Figure 27. Transformer Base

PC145D1064

QUANTITY REQD				CODE IDENT	PART NO. OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	ZONE	STOCK SIZE DIA	STOCK SIZE THICK	STOCK SIZE WIDTH	STOCK SIZE LENGTH	MATERIAL / MATERIAL SPECIFICATION / CONDITION VENDOR NAME AND ADDRESS	PROCESS SPECIFICATION LINE NUMBERS	FINISH CODE	MARK CODE	FIELD NOTES	TRACE CODE	LINE NO.
																		4
																		3
					-13	PLATE			.012	1.8	2.3	AL ALY 2024-T3 SH QQ-A-362				1		2
					PD145D1064-11	PLATE			.250	.7	.9	AL ALY 6061-T6 PL QQ-A-250/11						1

LIST OF MATERIAL

PART NUMBER MARKING PER MIL-STD-130

NEXT ASSEMBLY	USED ON	NEXT ASSY	FINAL ASSY
PC145D1061	SMS MICROTHRUSTER	1 OF -13	
SEE NOTE 2	SMS MICROTHRUSTER	1 OF -11	
APPLICATION		QUANTITY REQD	

WEIGHTS
TOTAL WEIGHTS
DASH NO.
WEIGHT

DO NOT SCALE DRAWING
ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED.
TOLERANCES UNLESS NOTED XX± .01 XXX± .005 ANG±

LAYOUT BY	
DRAWN BY	J.CHUNG 5-9-72
CHECKED	
ENGINEER	
STRUCTURES	
APPROVED	
CONTRACT NO.	NAS-5-11494

FAIRCHILD HILLER
FAIRCHILD REPUBLIC DIVISION
FARMINGDALE, NEW YORK 11735

PLATE DETAILS - CIRCUIT BOARD SMS MICROTHRUSTER

SIZE D | CODE IDENT NO. 77751 | PC145D1064
SCALE 2/1 | SHEET 1 OF

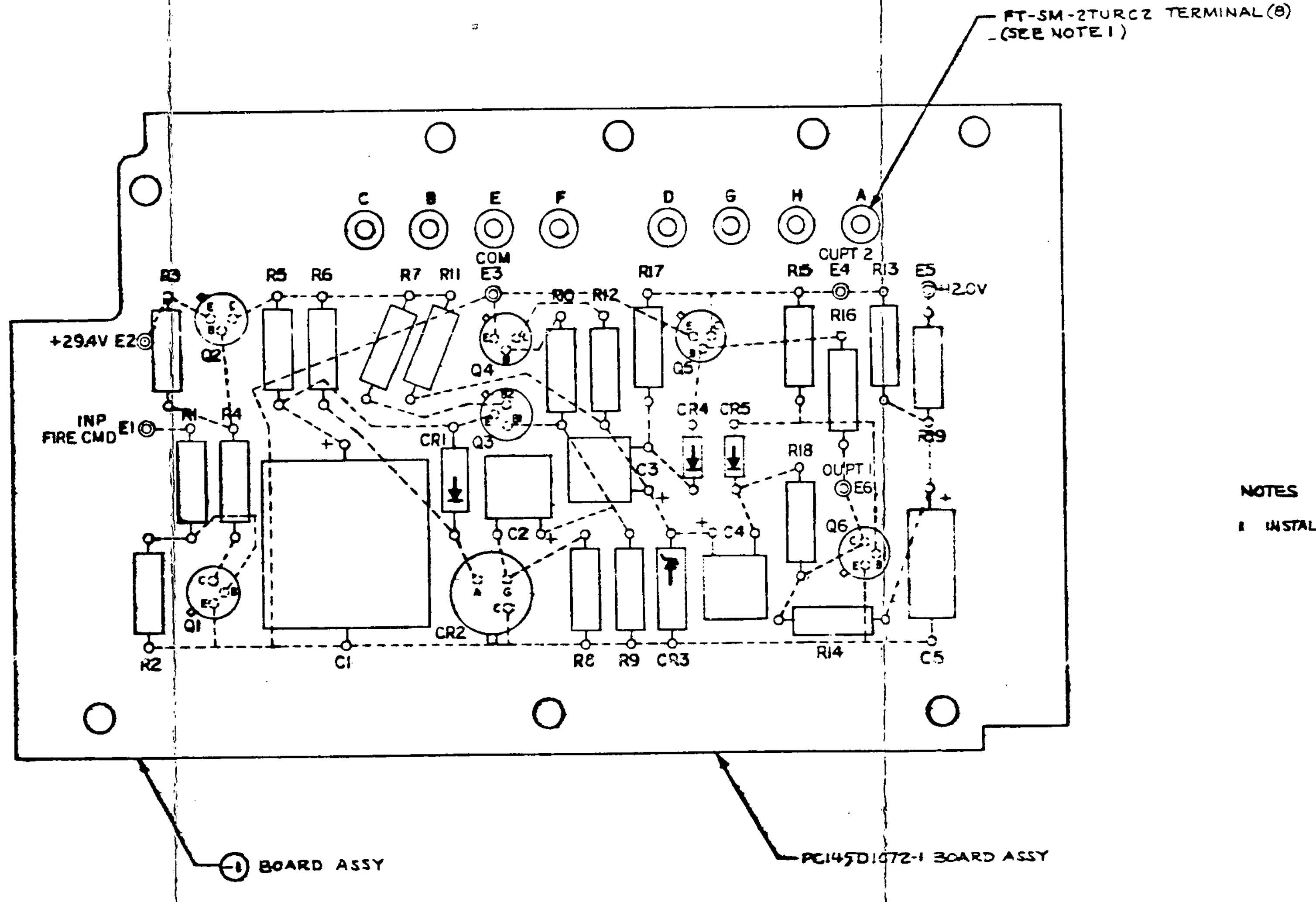
FR-8-12 DC

FOLDOUT FRAME 1

COMPONENT IDENTIFICATION	
ITEM	PART NUMBER
C1	CYR30C103JM
C2	CKR06BX223KR
C3, C4	CKR06BX222KR
C5	CSR13E106KS
CR1	TX1N649
CR2	TX2N2326A
CR3	TX1N753A
CR4, CR5	TX1N4148
Q1, Q4, Q5, Q6	TX2N2222A
Q2	TX2N3251A
Q3	TX2N4948
R1, R2	RCR20G203JS
R3, R6 / R13 THRU R16	RCR20G103JS
R4	RCR20G823JS
R5	RNR60E4993FS
R7	RCR20G152JS
R8	RCR20G102JS
R9, R19	RCR20G510JS
R10	RCR20G822JS
R11	RCR20G105JS
R12	RCR20G512JS
R17, R18	RCR20G104JS
~~A THRU H~~	FT-SM-2TURC2
E1 THRU E6	A-2307 EYELET (REF)

WIRING INFORMATION	
FROM	TO
E1	C
E2	B
E3	D
E4	G
E5	A
E6	H

FOLDOUT FRAME 2



NOTES

1. INSTALL TERMINALS FROM COMPONENT SIDE.

Figure 28. Delay Pulse Generator Board Assembly

FOLDOUT FRAME 3

QUANTITY REQD	VENDOR CODE IDENT	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL	MATL SPECIFICATION
✓			FLUX		MIL-F-14256
✓		SN63	SOLDER	TYPE S OR RMA	QQ-S-571
1		TX2N4948	TRANSISTOR		MIL-S-19500
1		TX2N3251A	TRANSISTOR		
1		TX2N2326A	DIODE		
4		TX2N2222A	TRANSISTOR		
2		TX1N4148	DIODE		
1		TX1N753A	DIODE		
1		TX1N649	DIODE		MIL-S-19500
1		RNR60E4993FS	RESISTOR		MIL-R-55182
1		RCR20G823JS			MIL-R-11
1		RCR20G822JS			
1		RCR20G512JS			
2		RCR20G510JS			
2		RCR20G203JS			
1		RCR20G152JS			
1		RCR20G105JS			
2		RCR20G104JS			
6		RCR20G103JS			
1		RCR20G102JS	RESISTOR		MIL-R-11
1		CYR30C103JM	CAPACITOR		MIL-C-23269
1		CSR13E106KS			MIL-C-39003
1		CKR06BX223KR			MIL-C-39014
2		CKR06BX222KR	CAPACITOR		MIL-C-39014
8	57771	FT-SM-2TRUC2	TERMINAL	(E.B. STIMPSON CO, BROOKLYN, N.Y.)	
1		PC145D1072-1	BOARD ASSEMBLY		
		PC145D1071-1	BOARD ASSEMBLY		
-1			ASSEMBLIES		

LIST OF MATERIAL

PART NUMBER MARKING PER MIL-STD-130

FAIRCHILD HILLER
REPUBLIC AVIATION DIVISION

PRINTED CIRCUIT BOARD ASSY - DELAY PULSE GENERATOR

SIZE J CODE IDENT NO. 77751 PC145D1071

SCALE 4X

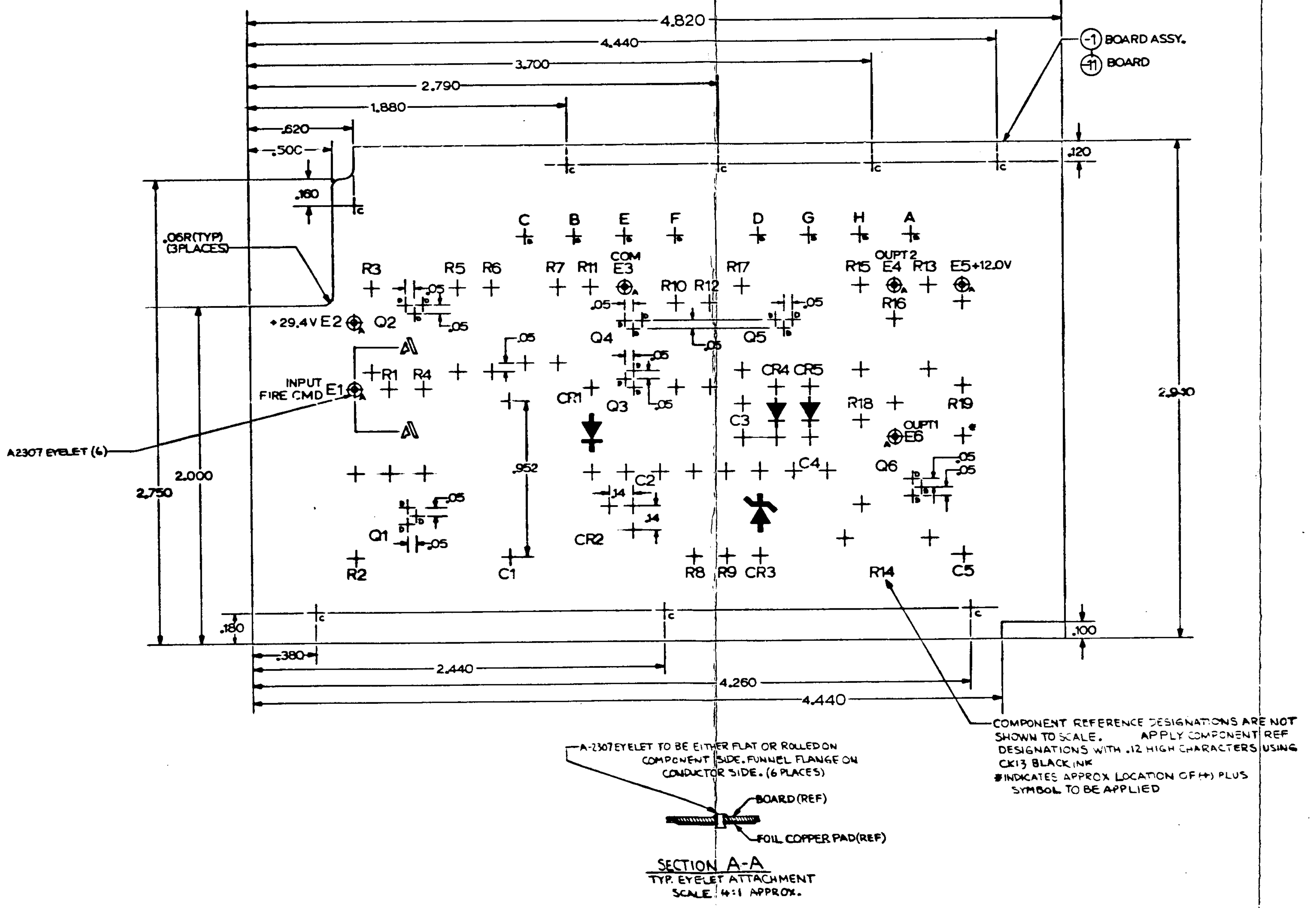
NEXT ASSEMBLY: PC145D1065 — QUANTITY REQD: 1 OF -1, 1 OF -1

FINISH: SEE NOTE

DO NOT SCALE DRAWING

PC145D1071

FOLDOUT FRAME 1



PC145D1072

C-40

FOLDOUT FRAME 2

DRILLING TABLE

HOLE SYM	DRILL SIZE	INSTALL	QTY
A	#54(.0550)	EYELET A-2307 (STIMPSON)	6
B	#27(.144)	DIA THRU	8
C	#33(.1130)	DIA THRU	8
UNMKD	#61(.0390)	DIA THRU	59
D	#74(.0225)	DIA THRU	18

C-41

FOLDOUT FRAME 3

Figure 29. Delay Pulse Generator Drill Drawing

QUANTITY REQD	CODE IDENT	PART NO. OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	STOCK SIZE	MATERIAL / MATERIAL SPECIFICATION / CONDITION / VENDOR NAME AND ADDRESS
✓	11722	CK-13	INK, BLACK		KRENGEL MFG - N.Y.C., N.Y.
6	57777	A-2307	EYELET		STIMPSON - BROOKLYN, N.Y.
1		-11	BOARD	.2623.06 .94	FL-GE062C1/0 B11A MIL-P-13949
		PC145D1072-1	DELAY PULSE GENERATOR & FLIP FLOP BOARD ASSY.		
-1			ASSEMBLY		

LIST OF MATERIAL

PART NUMBER MARKING PER MIL-STD-130

NEXT ASSEMBLY: PC145D1071 — QUANTITY REQD: 1 OF -1 (NEXT ASSY), 1 OF -1 (FINAL ASSY)

DO NOT SCALE DRAWING. ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED. TOLERANCES UNLESS NOTED .XX ±.03 .XXX ±.010 ANGLES

FAIRCHILD
Fairchild Republic Division Farmingdale New York 11735

BOARD ASSY- DELAY PULSE GENERATOR

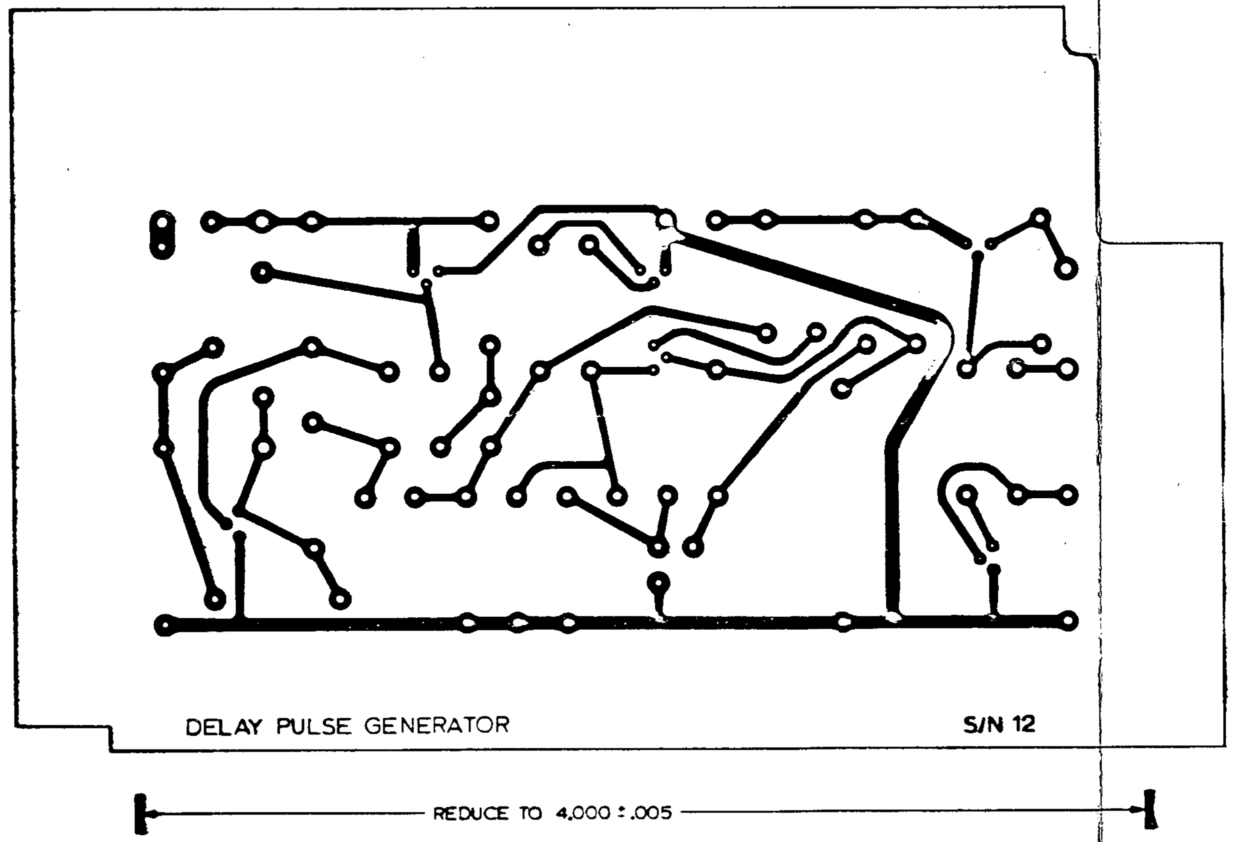
SIZE D CODE IDENT NO. 77751 PC145D1072

SCALE 4:1 SHEET OF

PC145D1072

FOLDOUT FRAME 1

PRECEDING PAGE BLANK NOT FILMED



FOLDOUT FRAME 2

NOTES-
1. THIS ARTWORK IS PREPARED TO AN ENLARGED SCALE AND MUST BE REDUCED TO ACTUAL SIZE TO PRODUCE THE PRINTED WIRING BOARD.
2. PRINTS OF THIS DWG ARE FOR REF ONLY.

FOLDOUT FRAME 3

PC145D1073

PC145D1073

Figure 30. Delay Pulse Generator Artwork

LIST OF MATERIAL

PART NUMBER MARKING PER MIL-STD-130

FAIRCHILD

ARTWORK PRINTED WIRING BOARD DELAY PULSE GENERATOR

77751 PC145D1073

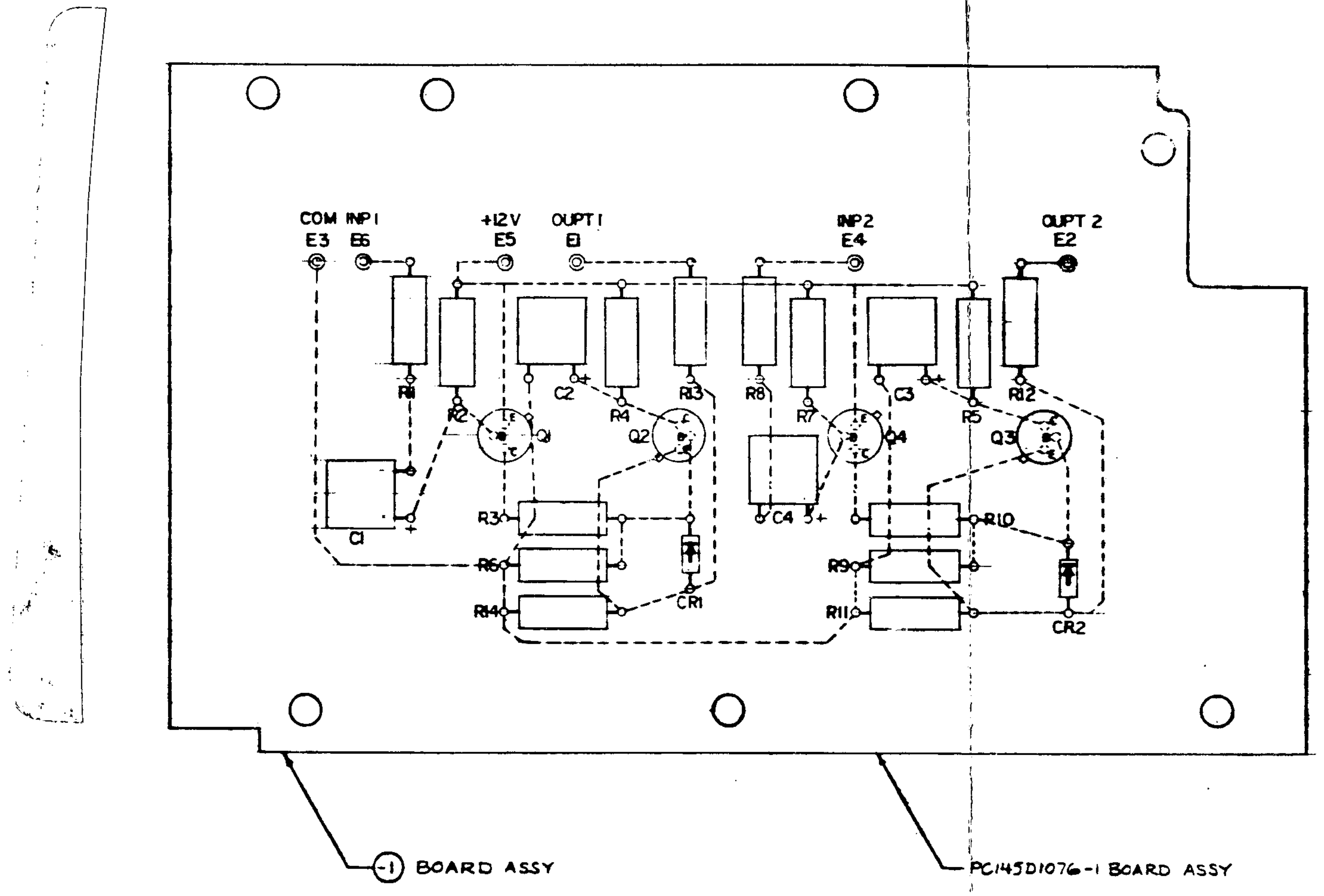
PC145D1072

APPLICATION

DO NOT SCALE DRAWING

PC145D1073

FOLDOUT FRAME 1



FOLDOUT FRAME 2

COMPONENT IDENTIFICATION	
ITEM	PART NUMBER
C1, C4	CKR06BX222KR
C2, C3	CKR06BX224KR
CR1, CR2	TX1N4148
Q1, Q4	TX2N3251A
Q2, Q3	TX2N2222A
R1, R3, R8, R10	RCR20G102JS
R2, R6, R7, R9, R11, R14	RCR20G103JS
R4, R5	RCR20G513JS
R12, R13	RCR20G510JS
E1 THRU E6	A-2307 EYELET (REF)

Figure 31. Pulse Driver Assembly

[redacted]

FOLDOUT FRAME 3

PC145D1075

QUANTITY REQD	SYM	VENDOR DATA PER	CODE IDENT	PART OR IDENTIFYING NO.	ZONE	NOMENCLATURE OR DESCRIPTION	STOCK SIZE	MATERIAL	MATL SPECIFICATION
✓						FLUX			MIL-F-14256
✓				SN63		SOLDER		TYPE S OR RMA	QQ-S-571
2				TX2N3251A		TRANSISTOR			MIL-S-19500
2				TX2N2222A		TRANSISTOR			MIL-S-19500
2				TX1N4148		DIODE			MIL-S-19500
2				RCR20G513JS		RESISTOR			MIL-R-11
2				RCR20G510JS		RESISTOR			MIL-R-11
6				RCR20G103JS		RESISTOR			MIL-R-11
4				RCR20G102JS		RESISTOR			MIL-R-11
2				CKR06BX224KR		CAPACITOR			MIL-C-39014
2				CKR06BX222KR		CAPACITOR			MIL-C-39014
1				PC145D1076-1		BOARD ASSEMBLY			
				PC145D1075-1		BOARD ASSEMBLY			
-1						ASSEMBLIES			

LIST OF MATERIAL

PART NUMBER MARKING PER MIL-STD-130

DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED

APPLICABLE SPECIFICATIONS

FINISH SEE NOTE

FAIRCHILD HILLER
REPUBLIC AVIATION DIVISION

PRINTED CIRCUIT BOARD ASSY
PULSE DRIVER

SIZE	CODE IDENT NO.	
J	77751	PC145D1075

SCALE 4X SHEET 1 OF 1

PC145D1075

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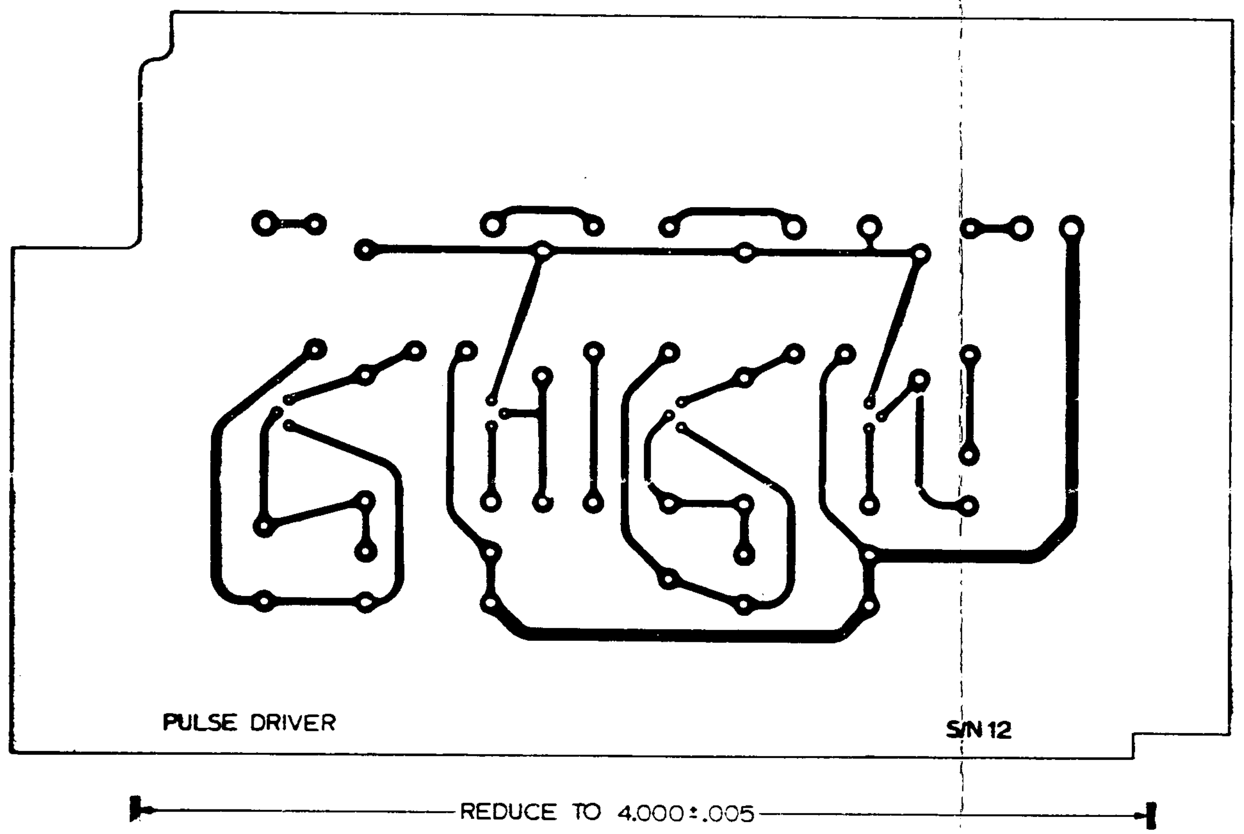
FOLDOUT FRAME 1



FOLDOUT FRAME 2

NOTES:
1. THIS ARTWORK IS PREPARED TO AN ENLARGED SCALE AND MUST BE REDUCED TO ACTUAL SIZE TO PRODUCE THE PRINTED WIRING BOARD.
2. PRINTS OF THIS DWG ARE FOR REF ONLY.

FOLDOUT FRAME 3

Figure 33. Pulse Driver Artwork

PC145D1077

PC145D1077

CODE IDENT | PART NO. OR IDENTIFYING NO. | NOMENCLATURE OR DESCRIPTION | ZONE | STOCK SIZE | MATERIAL | PROCESS SPECIFICATION | FINISH CODE | MARK CODE | FIELD NOTES | TRACE CODE | LINE NO.

PART NUMBER MARKING PER MIL-STD-130

PC145D1075 | NEXT ASSEMBLY | USED ON | APPLICATION

DO NOT SCALE DRAWING

FAIRCHILD
Fairchild Republic Division Farmingdale New York

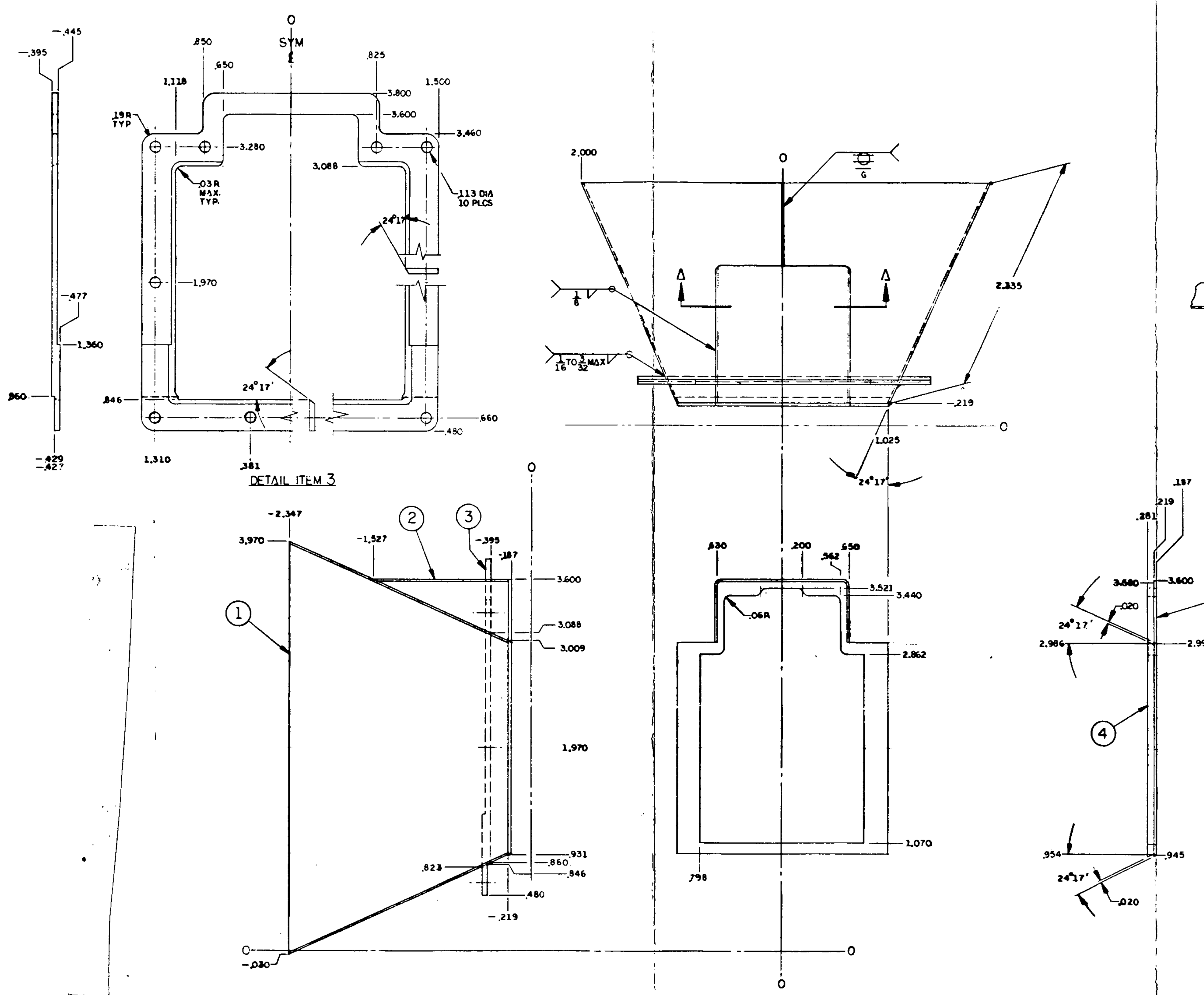
ARTWORK
PRINTED WIRING BOARD
PULSE DRIVER

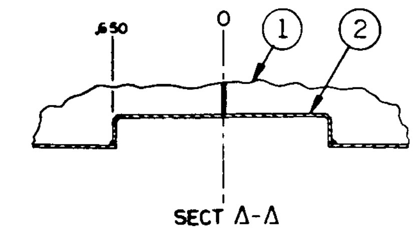
77751 PC145D1077

PC145D1077

FOLDOUT FRAME 1

FOLDOUT FRAME 2





ITEM	DESCRIPTION	STOCK SIZE	MATERIAL	REMARKS
1	CONE	.020 × 6.0 × 10.0	6061-0 AL ALY SH.	STRESS RELIEVE AFTER WELDING, HEAT TREAT TO T-6 CONDITION
2	EXTENSION	.020 × 1.5 × 2.8	6061-0 AL ALY SH.	
3	FLANGE	.090 × 3.2 × 3.5	6061-0 AL ALY SH.	
4	BASE	.062 × 2.5 × 3.0	NEMA G-10 FIBRE GLAS	
5	BASE EXTN	.032 × 2.5 × 3.0	NEMA G-10 FIBRE GLAS	

TOL: 3 PL ±.005 ANGULAR ± 0°15'

CONE ASY

PC145D1080

Figure 34. Exhaust Cone Assembly

c-51

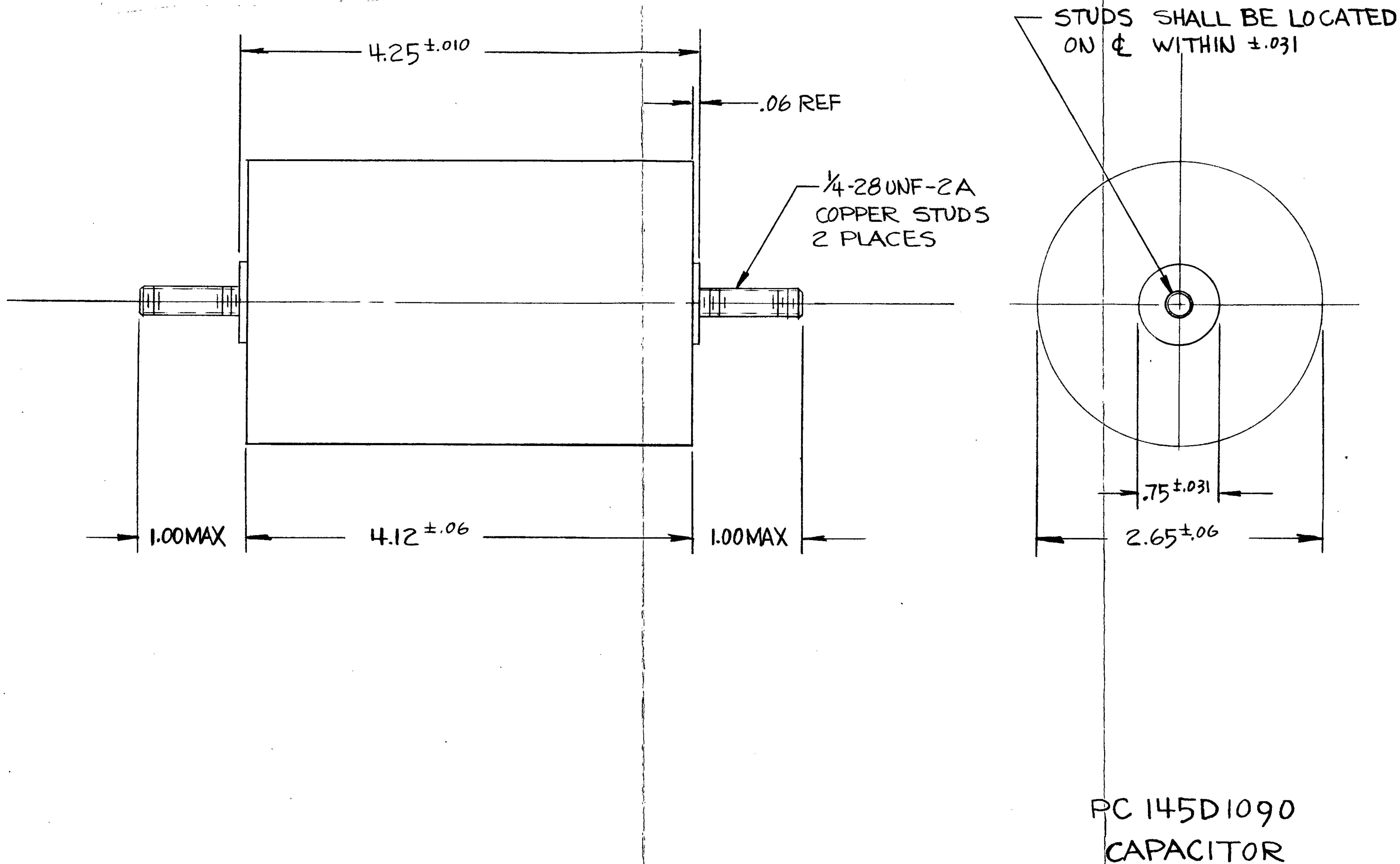


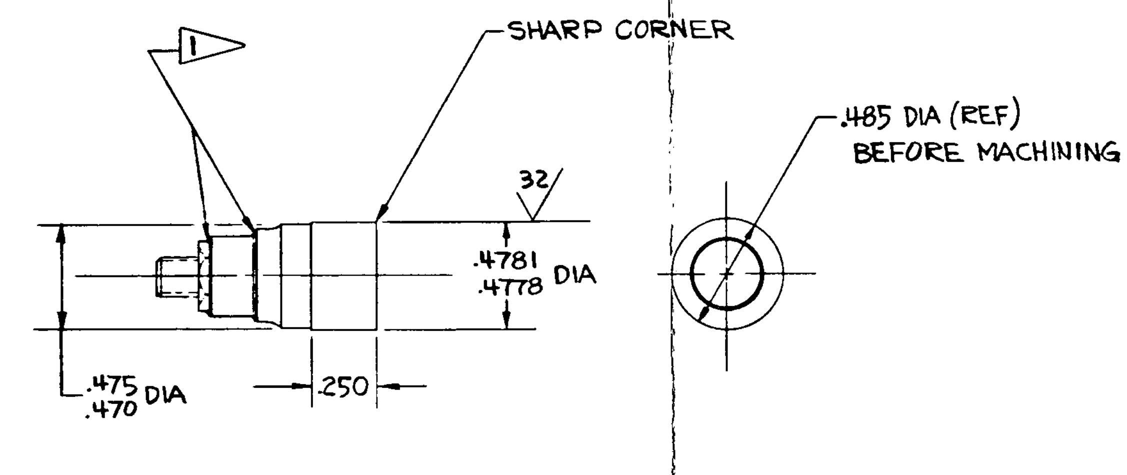
Figure 35. Capaciter, SCD

c.53

FOLDOUT FRAME 1

FOLDOUT FRAME 2

PC145D1091	TYPE OF CHANGE	EAI INC	REWORK PERMIT YES	REWORK PERMIT NO	SYM	REVISIONS DESCRIPTION	DATE	APPROVED



(-1) IGNITER PLUG

NOTES:

1. APPLY A LIGHT BEAD OF EPOXY CEMENT (5/50 BY WT OF EPON 828 AND VERSAMID 140) ALL AROUND, THEN CURE AT 65°C (140°F) FOR 24 HOURS.

Figure 36. Igniter Plug, SCD

PC145D1091

QUANTITY REQD				SYM	VENDOR DATA PER	CODE IDENT	PART OR IDENTIFYING NO.	ZONE	NOMENCLATURE OR DESCRIPTION	STOCK SIZE DIA	STOCK SIZE THICK	STOCK SIZE WIDTH	STOCK SIZE LENGTH	MATERIAL	SPECIFICATION	TS 1000 PSI	UNIT WT
							PC145D1091-1		IGNITER PLUG	(MAKE FROM				#10-380729-1 BENDIX SCINTILLA DIV) SYDNEY, N.Y.	PC145S8008		

LIST OF MATERIAL

PART NUMBER MARKING PER MIL-STD-130

UNAUTHORIZED USE, MANUFACTURE OR REPRODUCTION IN WHOLE OR IN PART IS PROHIBITED. DRAWING, DESIGN AND OTHER DISCLOSURES PROPERTY OF FAIRCHILD HILLER CORPORATION.

NEXT ASSEMBLY	USED ON	NEXT ASSY	FINAL ASSY
PC145D1035	SMS MICROTHRUSTER	2 OF -1	2 OF -1
APPLICATION		QUANTITY REQD	

DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED		DRAWN	J. CHUNG 5-15-72
DEC TOL	SH MET. RAD	CHECKED	
2 PLACE ±.	BEND:	GR ENGR	
3 PLACE ±.005	COR:	STRUCT	
ANGULAR ±	DEBURR ALL EDGES	WEIGHTS	
APPLICABLE SPECIFICATIONS			
FINISH:		PROJ ENGR	
HEAT TREAT:			
BEND RELIEF:			
FOR ADDL SPEC SEE NOTE		CONTRACT NO. NAS-5-11494	
DO NOT SCALE DRAWING			

FAIRCHILD HILLER
REPUBLIC AVIATION DIVISION
FARMINGDALE, LONG ISLAND, NEW YORK

IGNITER PLUG
NEGATIVE ELECTRODE
SMS MICROTHRUSTER

SIZE	CODE IDENT NO.	
C	77751	PC145D1091
SCALE 2/1	UNLESS OTHERWISE NOTED	SHEET

FORM RAD 141

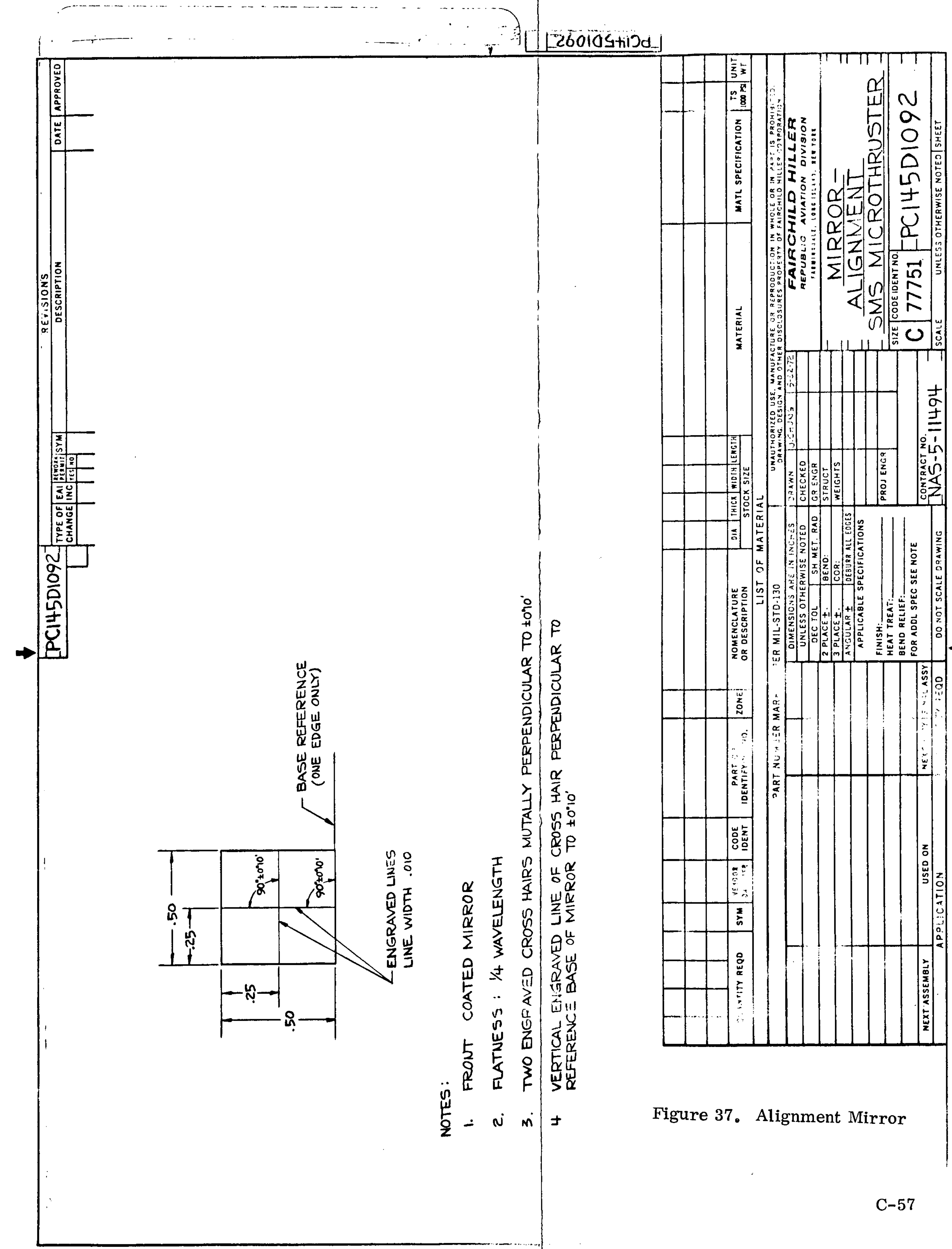


Figure 37. Alignment Mirror

APPENDIX D. TENTATIVE DRAWINGS OF WILMORE ELECTRONICS POWER CONDITIONER

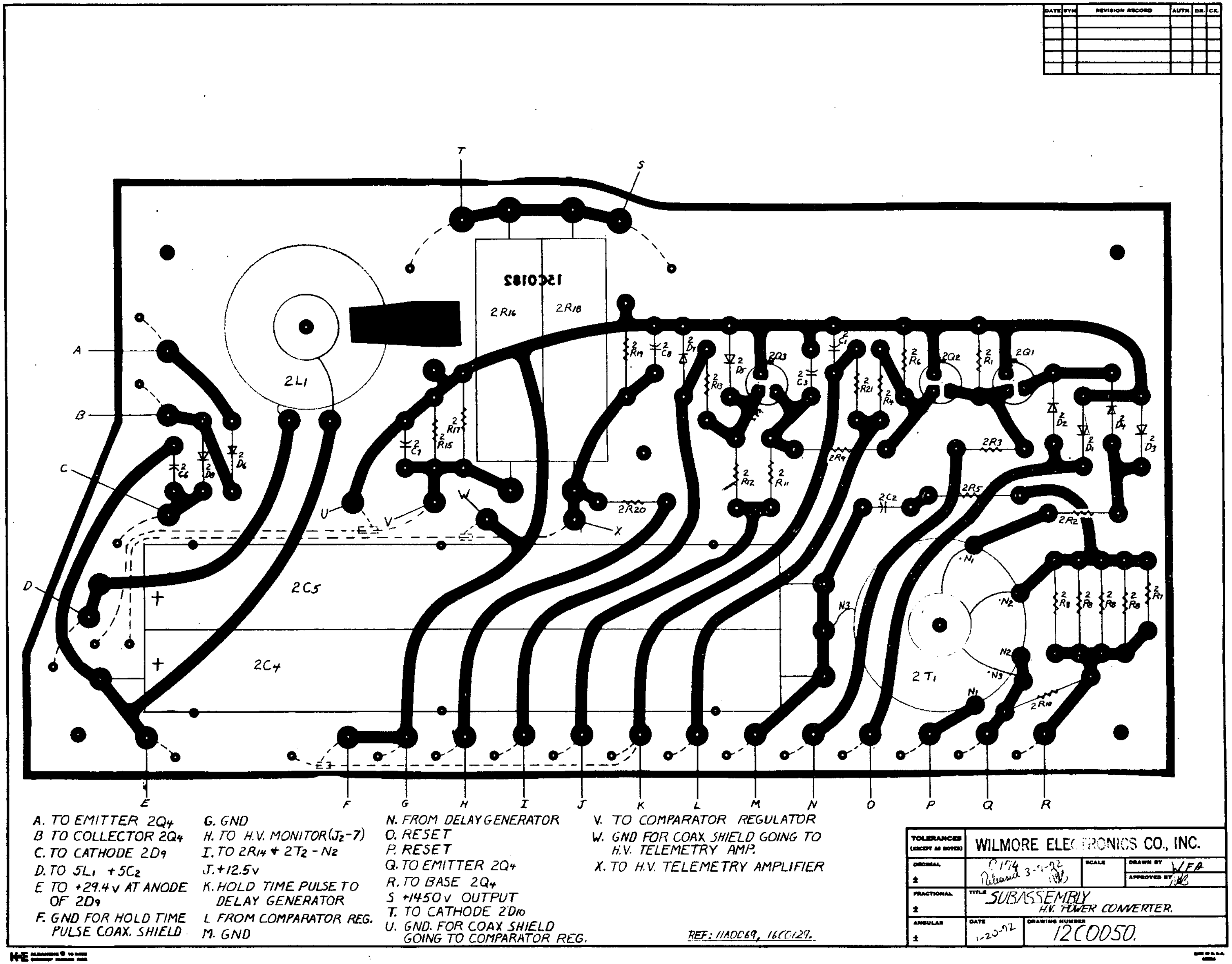


Figure 38. Subassembly High Voltage Power Conditioner

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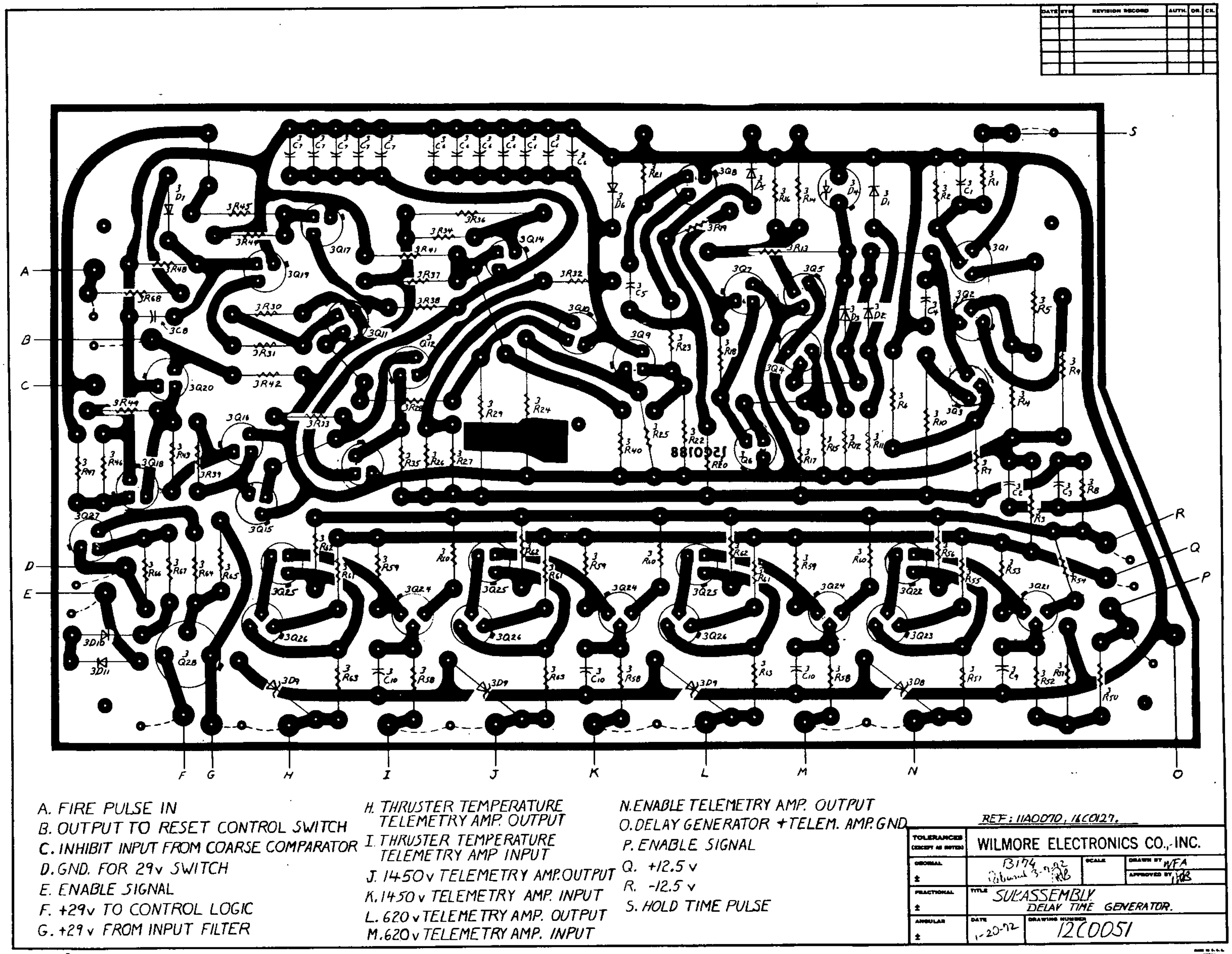

Figure 39. Subassembly Delay Trigger Generator

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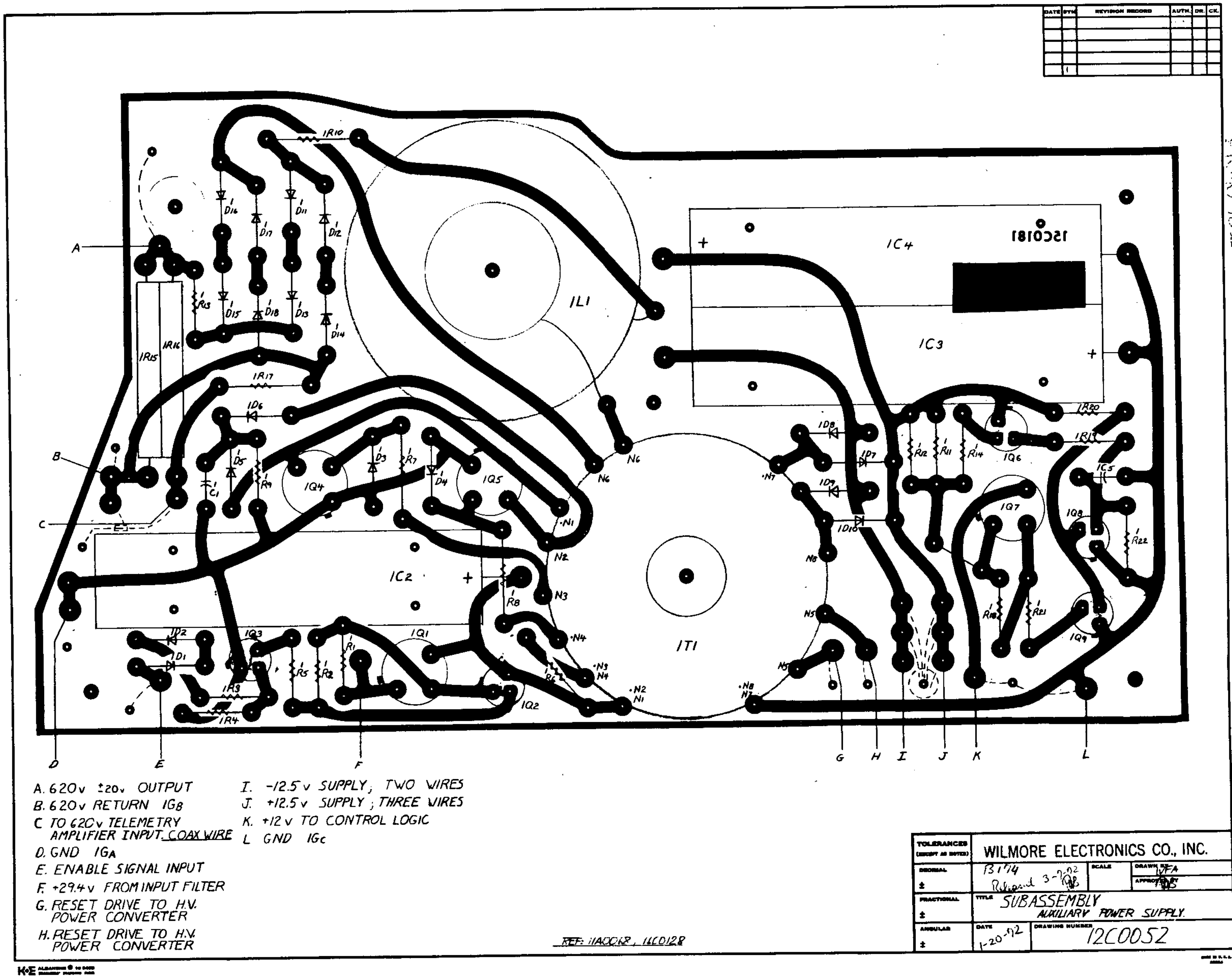

Figure 40. Subassembly Auxiliary Power Supply

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FAIRCHILD
REPUBLIC DIVISION

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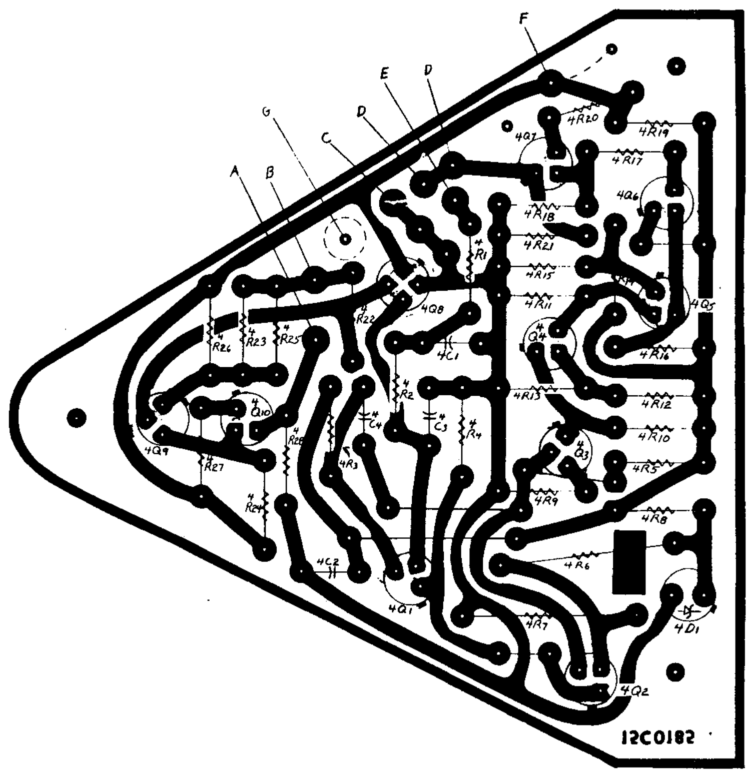

A. OUTPUT - TO INHIBIT OF DELAY GENERATOR
B. -12.5v
C. GND. FOR THREE COAX SHIELDS
D. OUTPUT - TO RESET CONTROL OF H.V. CONVERTER. TWO SHIELDED WIRES
E. INPUT FROM H.V. DIVIDER. ONE SHIELDED WIRE
F. +12.5v
G. HOLE FOR WIRES GOING TO POINTS A, B, C, D, E THREE COAX ; TWO STRANDED

PRECEDING PAGE BLANK NOT FILMED

FAIRCHILD
REPUBLIC DIVISION

TOLERANCES (EXCEPT AS NOTED)	WILMORE ELECTRONICS CO., INC.
DECIMAL ±	B174 Cleared 3-7-72 · SCALE · DRAWN BY WFA · APPROVED
FRACTIONAL ±	TITLE SUBASSEMBLY COMPARATOR REGULATOR.
ANGULAR ±	DATE 1-20-72 · DRAWING NUMBER 12C0053

REF: 11AC071, 16C0130.

Figure 41. Subassembly Comparator Regulator

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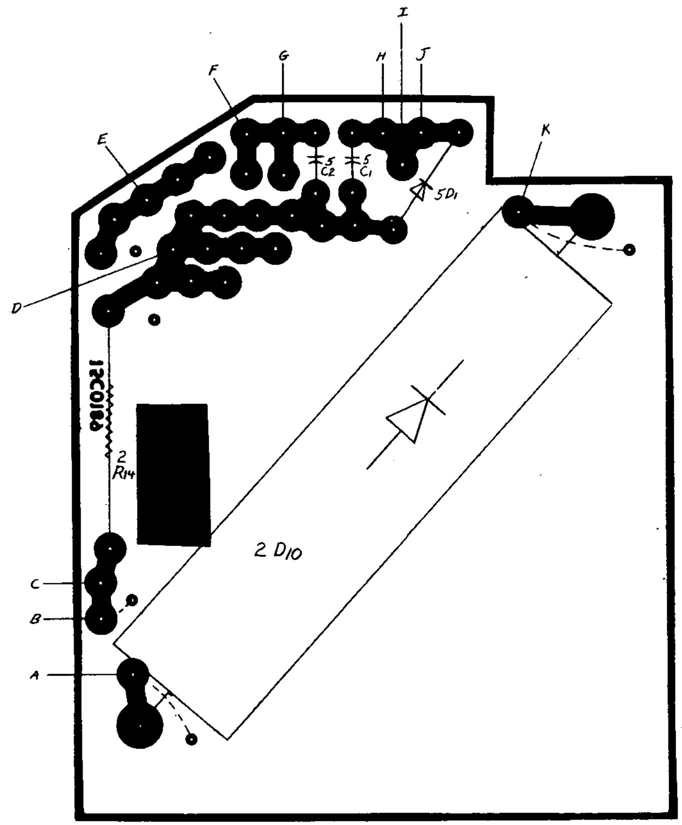

A: TO $2T_2$ - N_2
B. TO $2T_2$ - N_2
C. FROM $2R_{13}$ + ANODE $2D_7$
D. COMMON GND NODE
E. COMMON ENABLE POINT
F. FILTERED +29.4 v POINT
G. TO $5L_1$
H. TO $5L_1$
I. +29.4 v POWER INPUT E.M.I. FILTER
J. TO HARD WIRE MONITOR (J2 -5)
K. +1450 v TO $2R_{16}$ + $2R_{18}$

2D10 AND 2R14 SHOWN ON 16C0129 SCHEMATIC
5D1 5C1 5C2 ARE SHOWN ON 16C0131 SCHEMATIC

REF 11AC072 16C0131 12C0056

TOLERANCES (EXCEPT AS NOTED)	WILMORE ELECTRONICS CO., INC.
DECIMAL ±	SCALE / DRAWN BY NFA / APPROVED BY
FRACTIONAL ±	TITLE SUBASSEMBLY POWER TRANSFORMER
ANGULAR ±	DATE 2-7-72 / DRAWING NUMBER 12C0056

Figure 42. Subassembly Power Transformer

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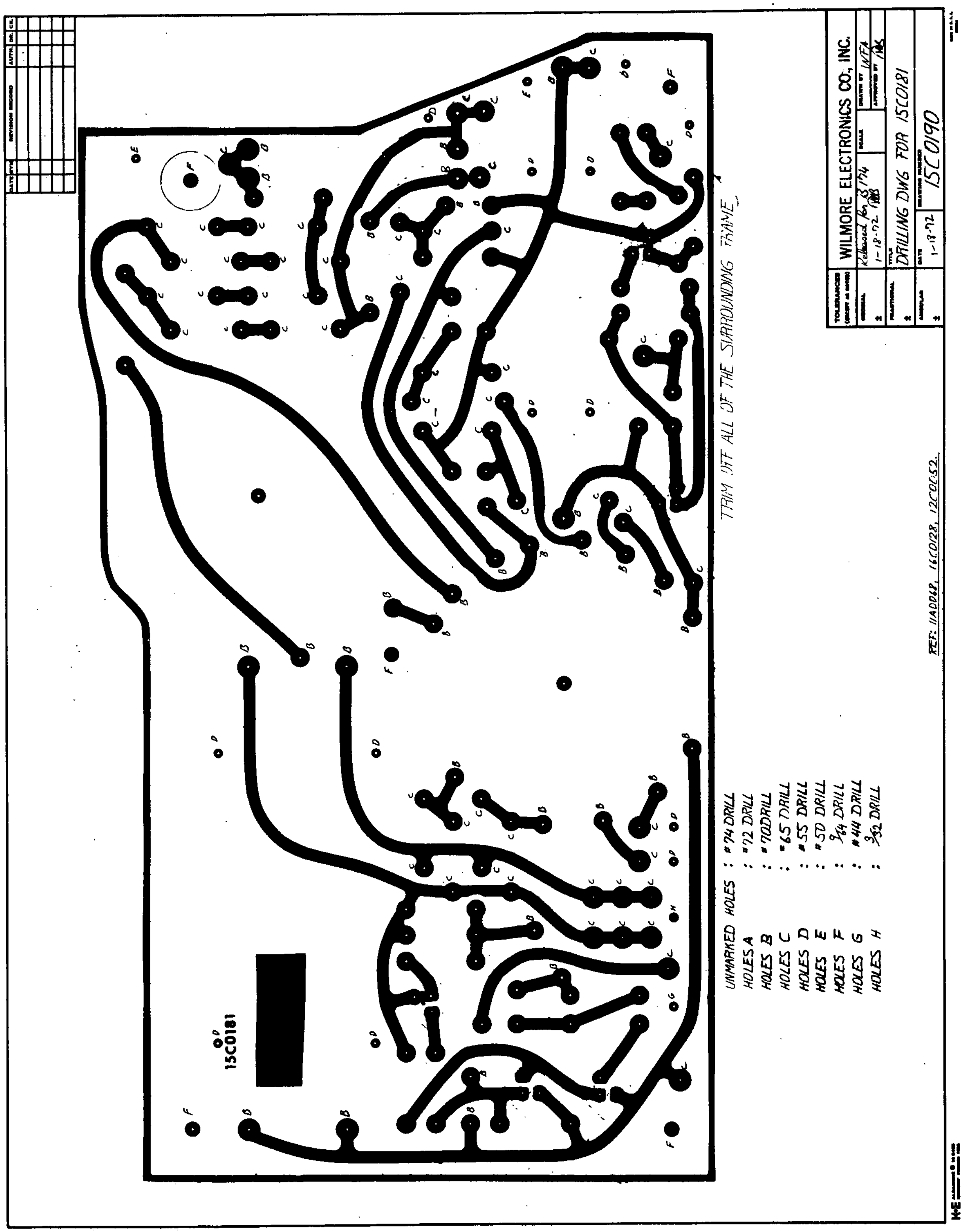

Figure 43. Drill Drawing for 15C0181

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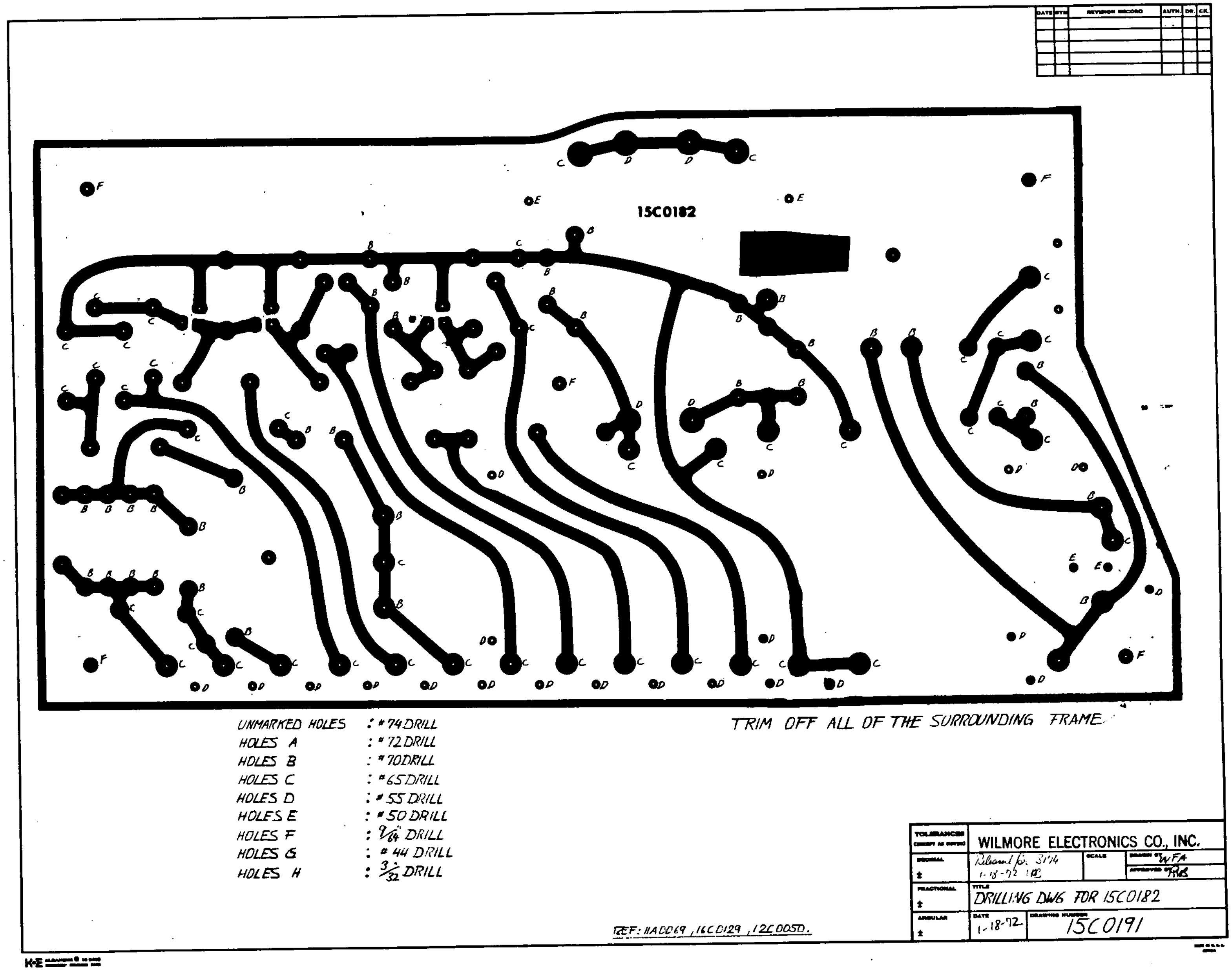

Figure 44. Drill Drawing for 15C0182

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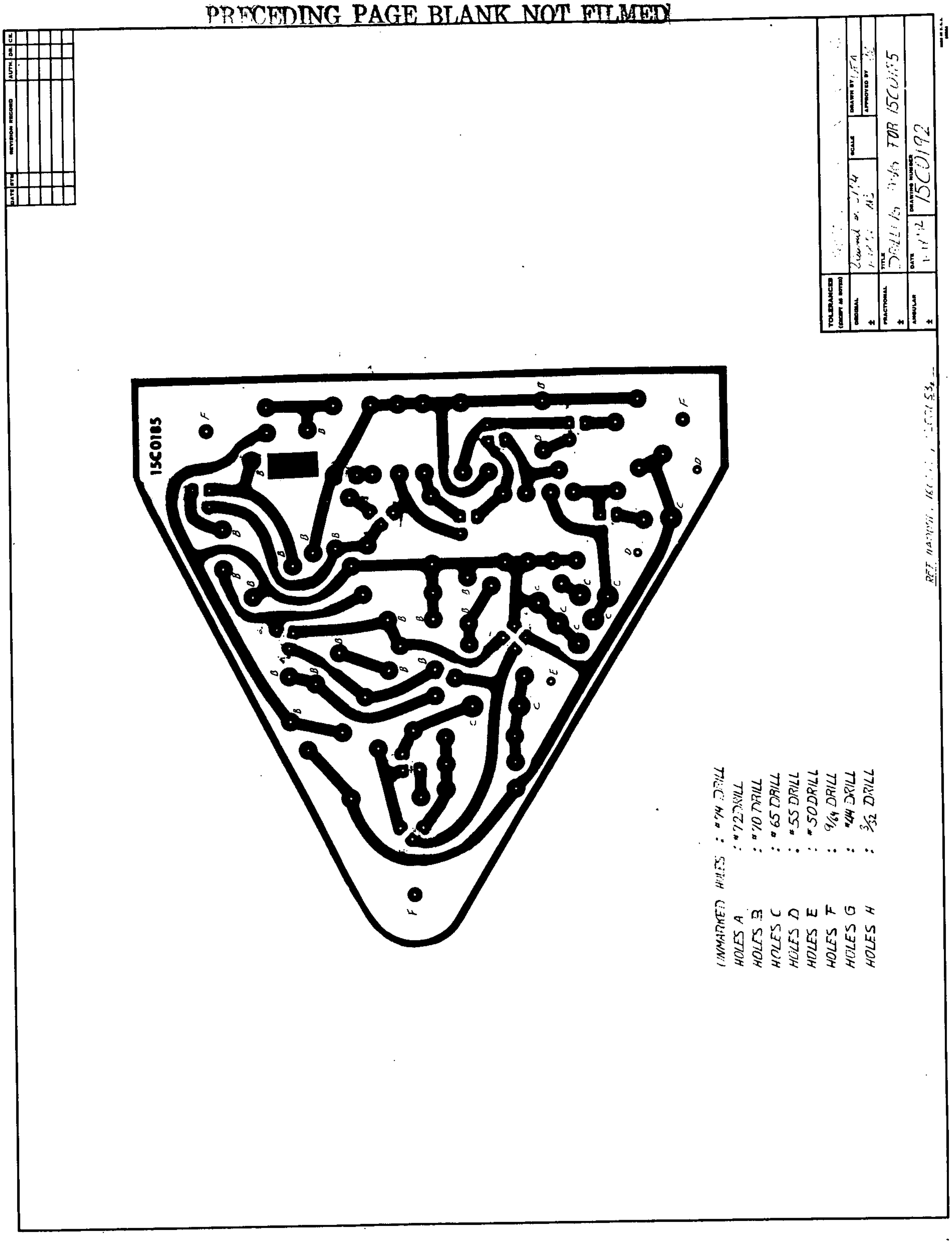

Figure 45. Drill Drawing for 15C0185

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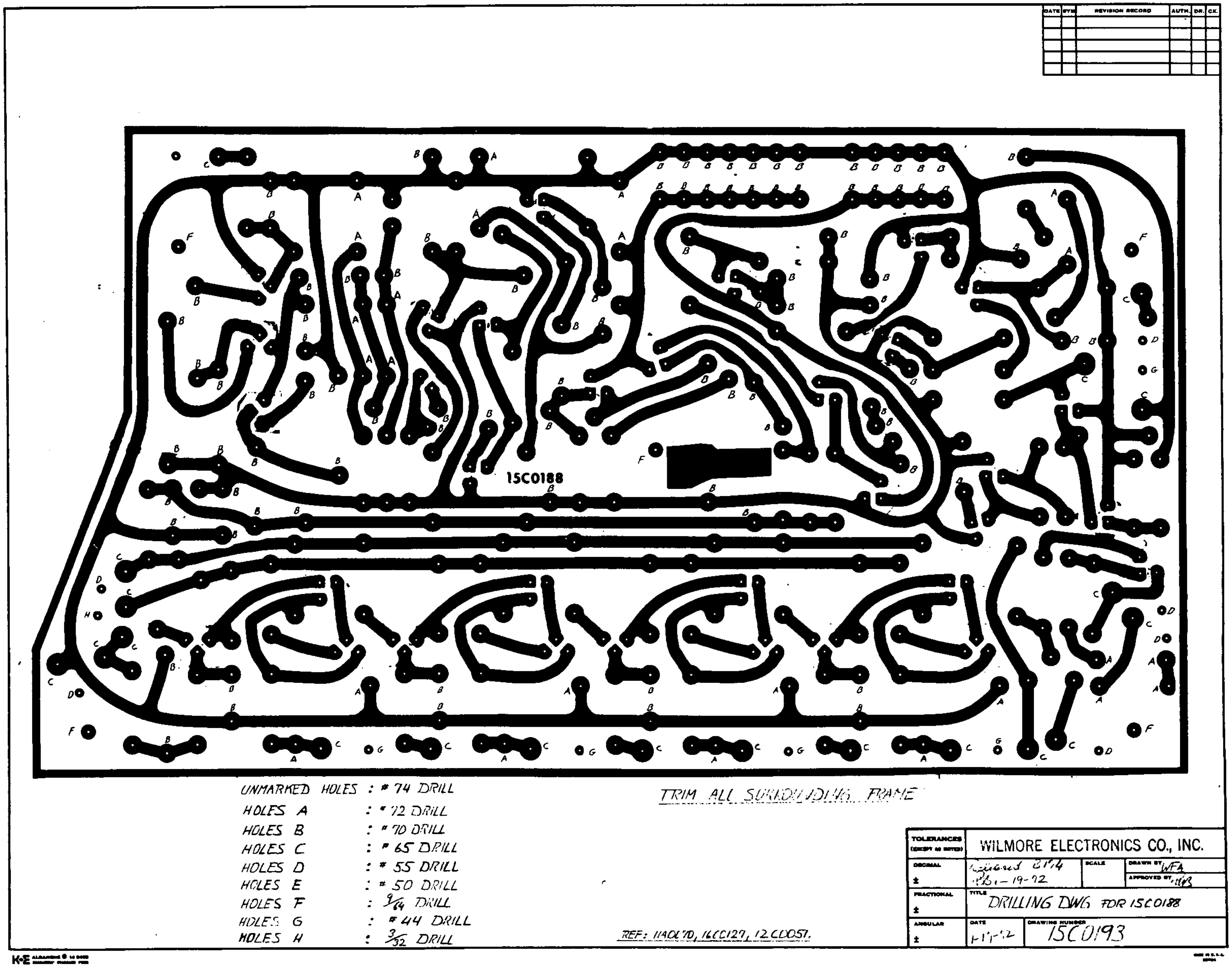

Figure 46. Drill Drawing for 15C0188

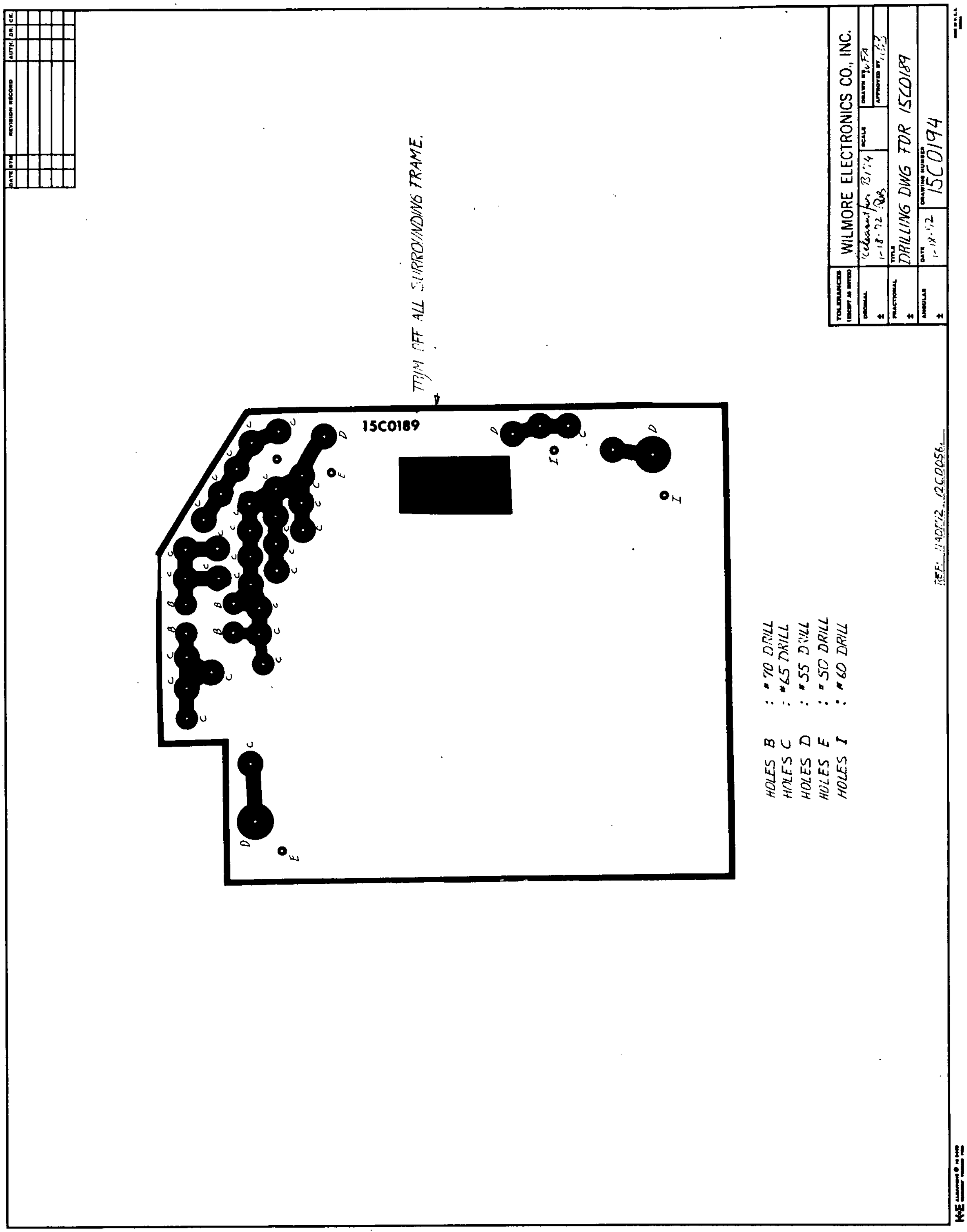

Figure 47. Drill Drawing for 15C0189

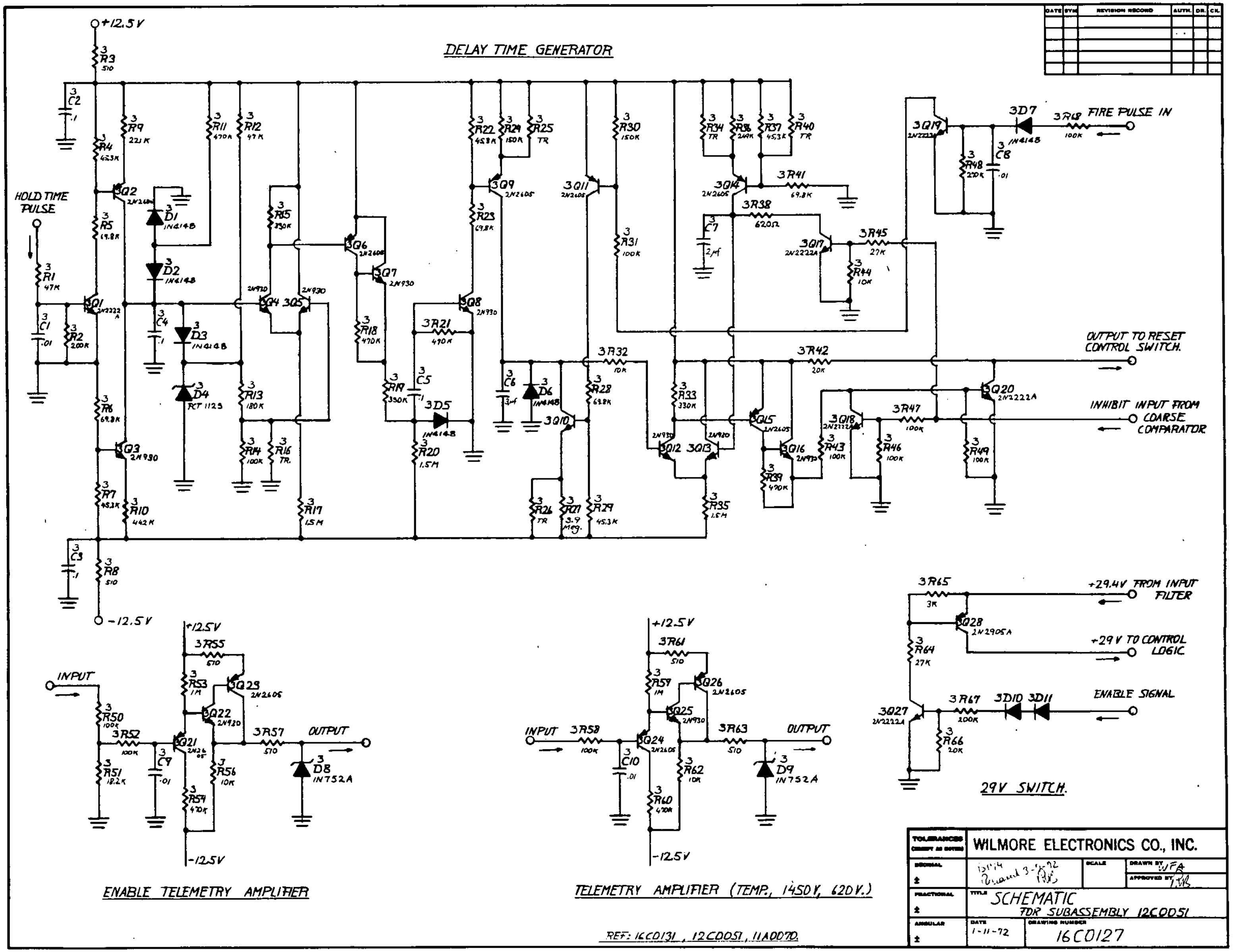

Figure 48. Schematic for Subassembly 12C0051

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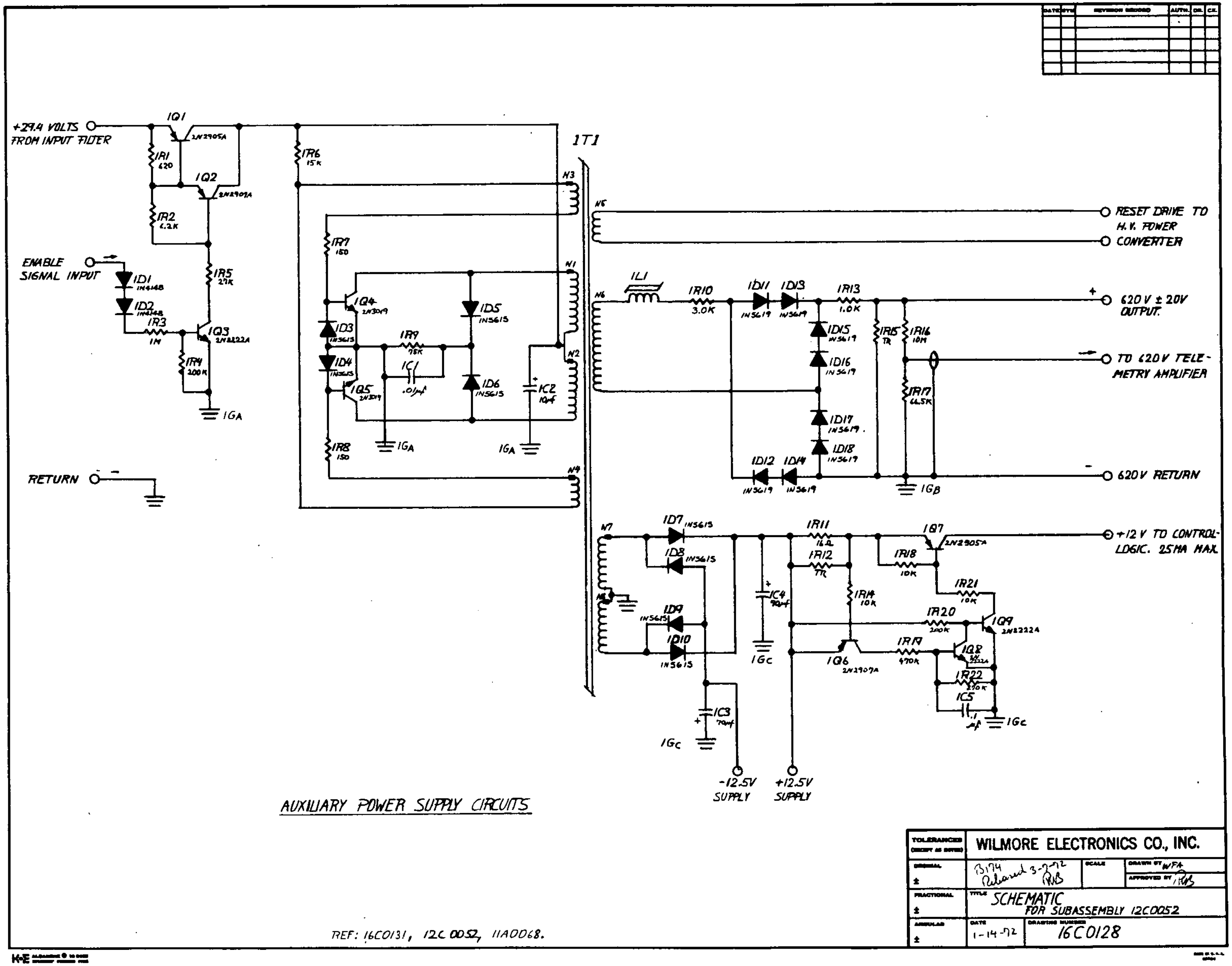

Figure 49. Schematic for Subassembly
12C0052

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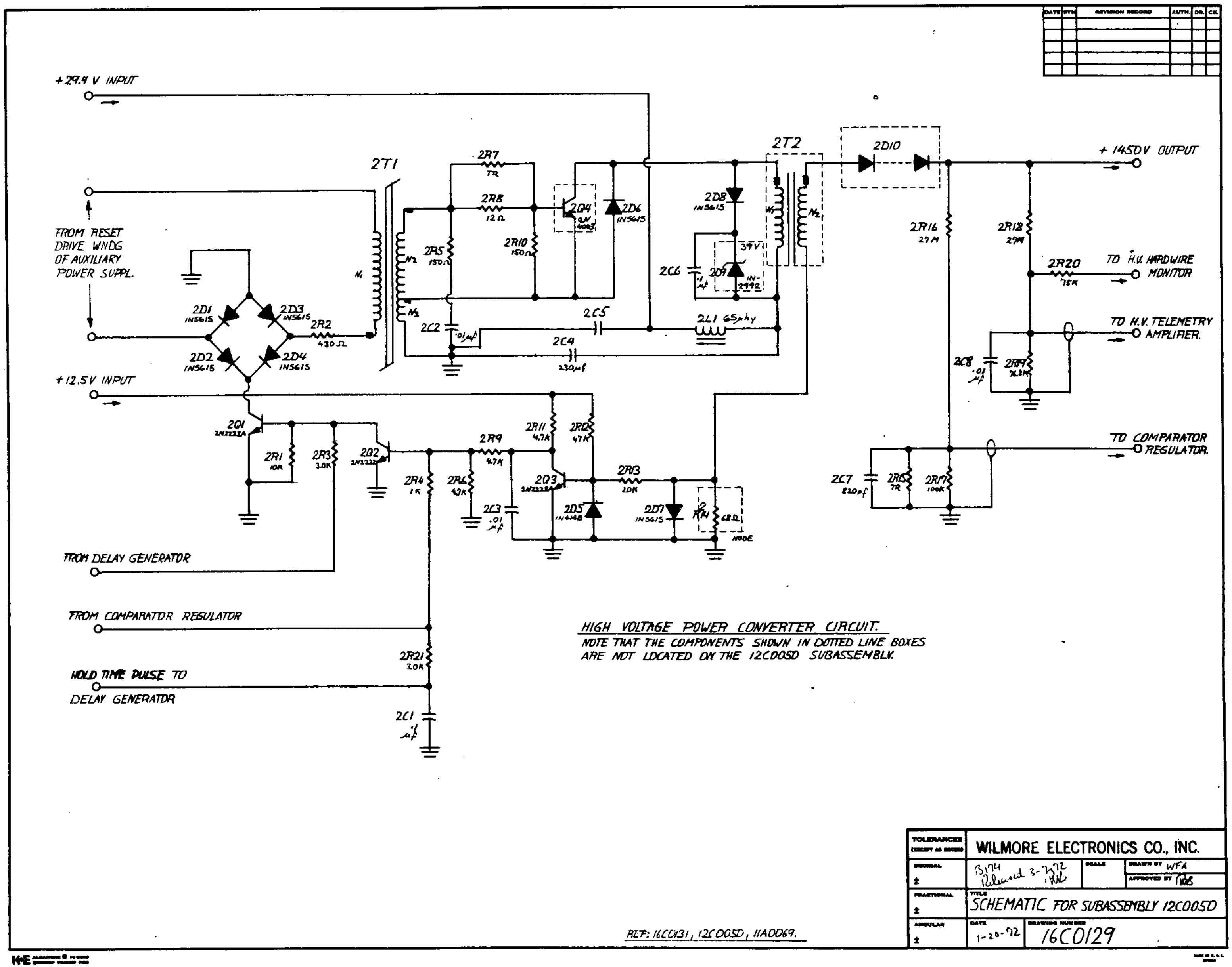

Figure 50. Schematic for Subassembly 12C0050

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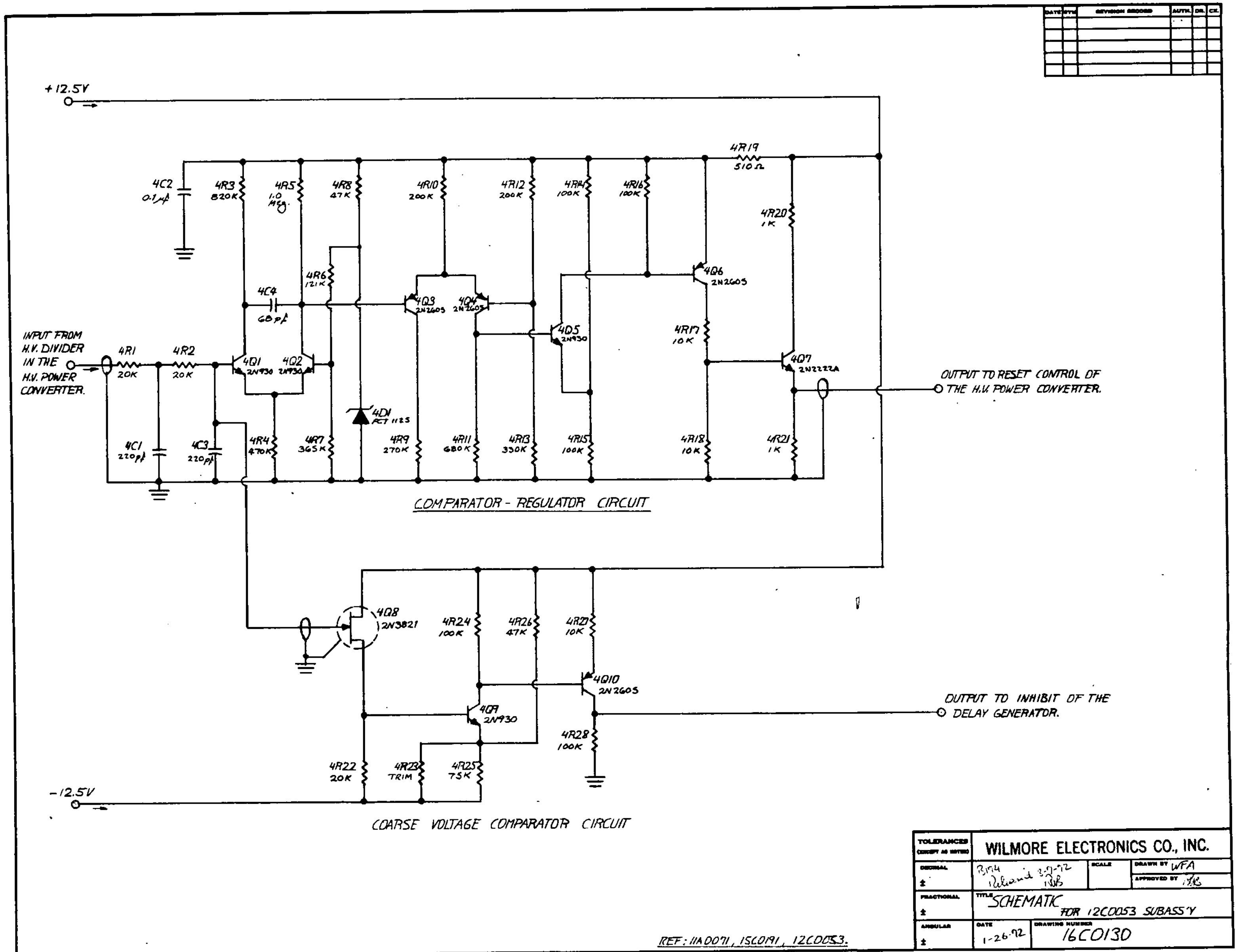

Figure 51. Schematic for Subassembly 12C0053

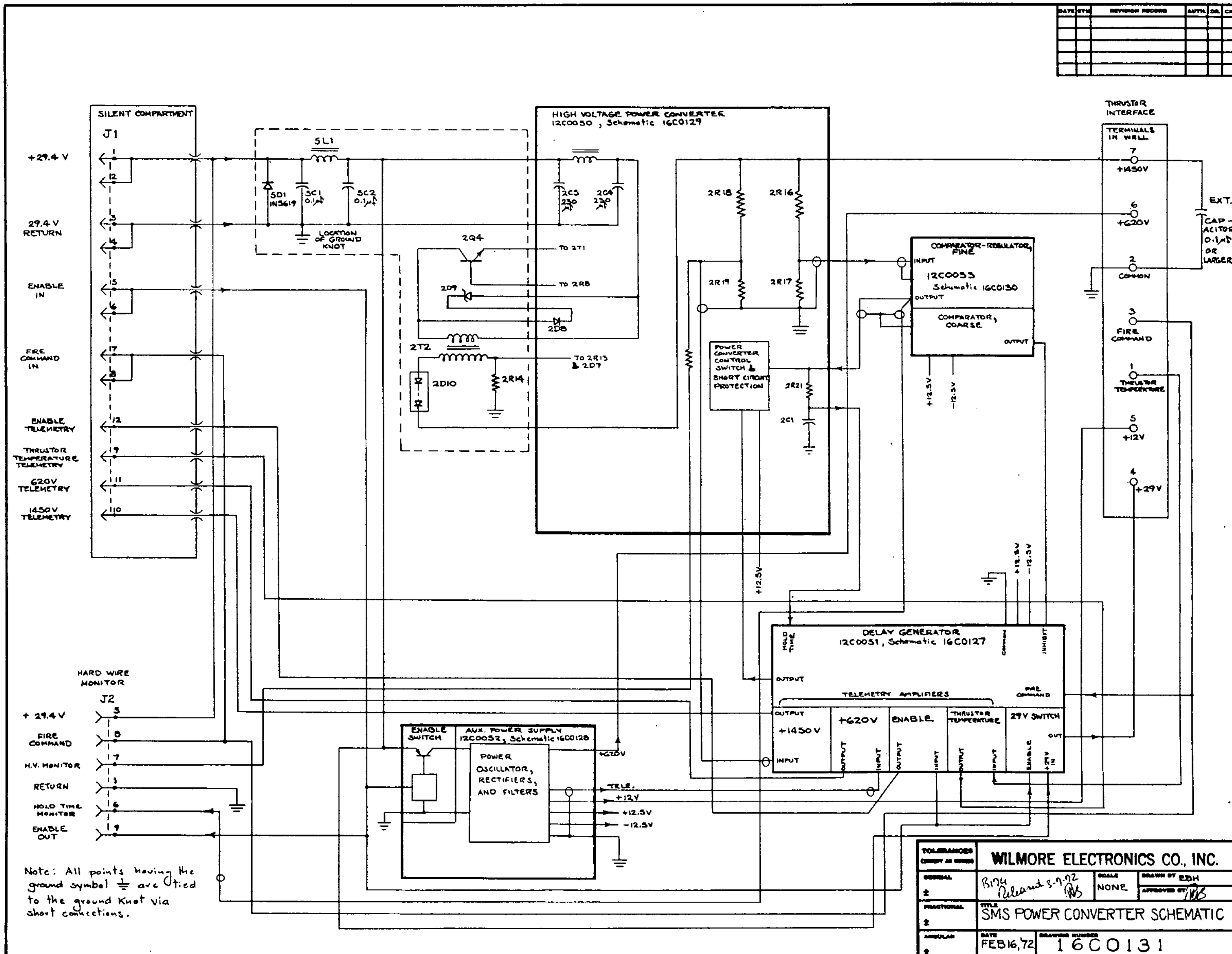

Figure 52. Converter Schematic

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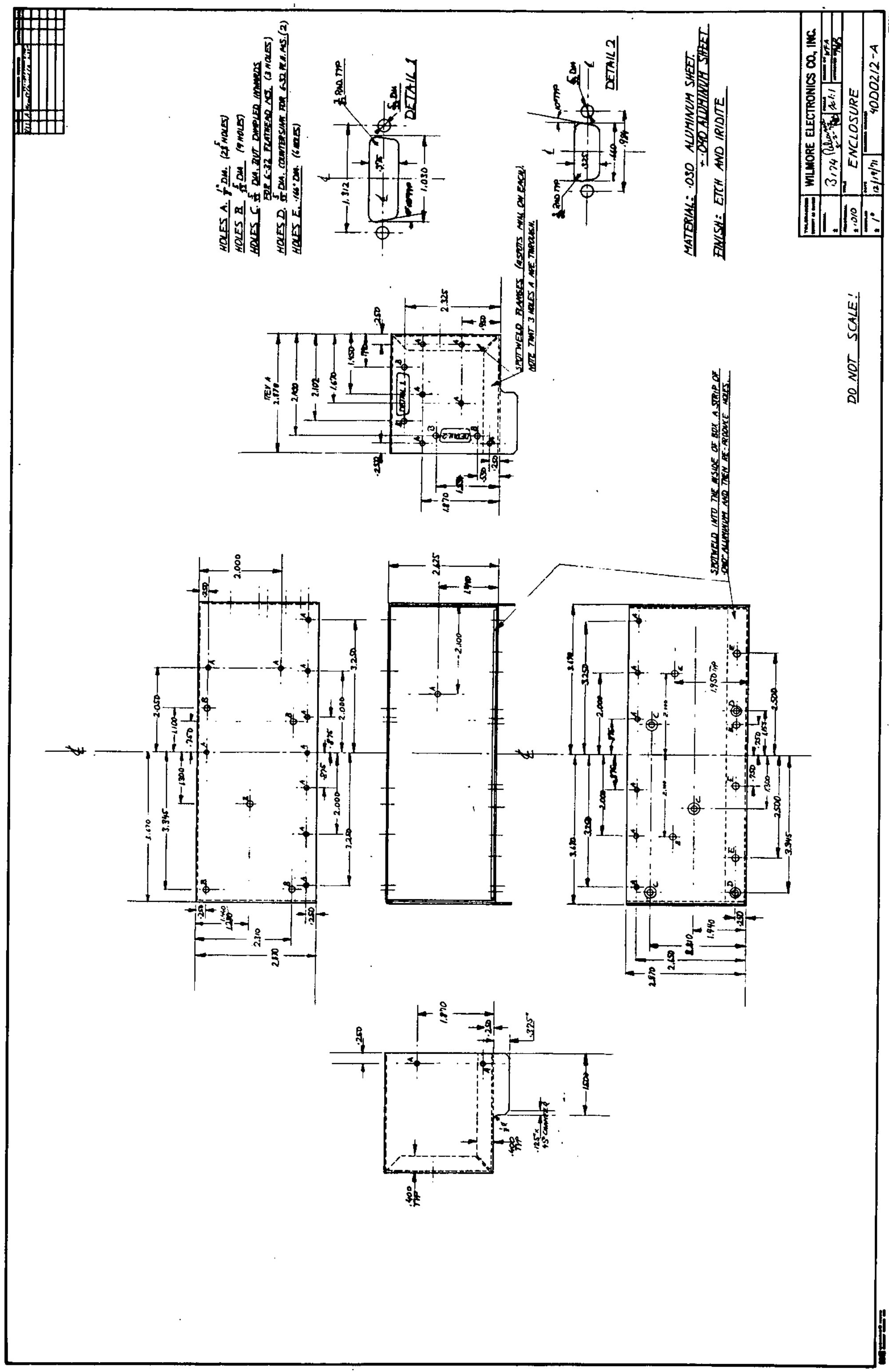

Figure 53. Enclosure

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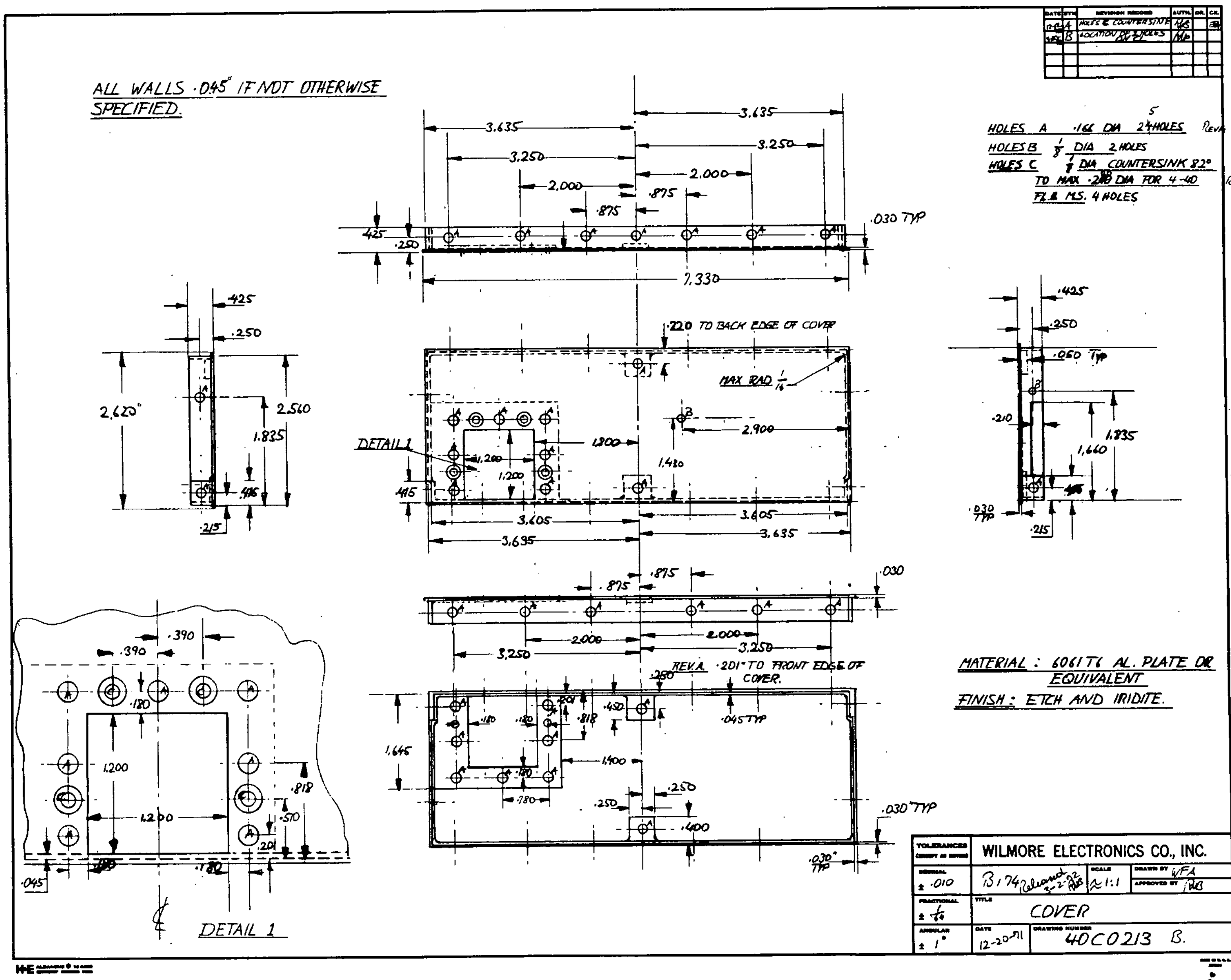

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Figure 54. Cover

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