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Analytical Thermal Analysis of the L-Band Transmitter Replacement

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An L-band transmitter was designed to replace an existing unit. Increased transmitter reliability and increased mean time between failures were of primary concern for the new design. This report details the thermal analysis and design for a transmitter which operates in a sol-air temperature of 110°F (43°C) with zero wind speed. The thermal modeling programs used are Radiation View Factor (RAVFAC) and Systems Improved Numerical Differencing Analyzer (SINDA). The RAVFAC program is supported by a plotting program, Ravplot, and a data reduction program, Colaps.

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ANALYTICAL THERMAL ANALYSIS OF THE L-BAND TRANSMITTER REPLACEMENT

INTRODUCTION

The Terrestrial Systems Branch undertook a task to design an L-band transmitter to replace an existing unit with requirement of improving transmitter reliability by increasing the mean time between failures. A comprehensive, analytical thermal analysis was conducted on the L-band transmitter replacement to identify possible "hot spots." Early detection facilitates the use of proper thermal design to minimize the number and severity of hot spots.

The incorporation of proper thermal design with the electromechanical design will increase electronic component life by decreasing temperature rise. Furthermore, the allowable ambient operating temperature will increase due to improved heat transfer.

The analysis was conducted using several well-established thermal computer programs. Developed by the aerospace industries for the National Aeronautics and Space Administration (NASA), these thermal computer programs have proven successful through many space flight missions.

MECHANICAL DESIGN CONSIDERATIONS AND CONSTRAINTS

Special mechanical design considerations were included to meet the demands of anticipated future systems. Mechanical designs that directly impact the thermal design are detailed below.

To facilitate the replacement of the existing transmitter, the baseplate and mounting holes for the new design match those of the original unit. In addition, the locations of external connectors were maintained whenever possible. The only through holes permitted in the casing of the new design were the connector and pressure fitting holes. This limits the number of possible pressure leaks.

The casing was designed to be purged and pressurized with nitrogen or dry air when a protective radome is not provided. Also, whenever possible, the use and contact of dissimilar metals on and in the casing was avoided to limit electrochemical attack, primarily from rain and salt spray.

The casing walls were constructed of 3/8-in. aluminum plate. This allowed the insertion of number 8 and 10 locking threaded coils without rupturing the walls. The baseplate constructed of half-inch aluminum was the major heat sink of the casing.

The interior of the casing was designed using a modular concept so that each component was a separate entity (Figs. 1 and 2). Each component was attached to a mounting bracket, which in turn was attached to the transmitter casing by way of 10-32 threaded captive screws held to the mounting bracket by captive fasteners. Each modular unit was totally accessible to maintenance personnel for removal.

The mounting brackets are fabricated from quarter-inch aluminum plate, except for the power supplies which require half-inch plate for additional heat sinking. Quarter-inch plate was needed to bottom mount several components to mounting brackets with flathead screws. A thinner plate prohibits proper countersinking of mounting holes.

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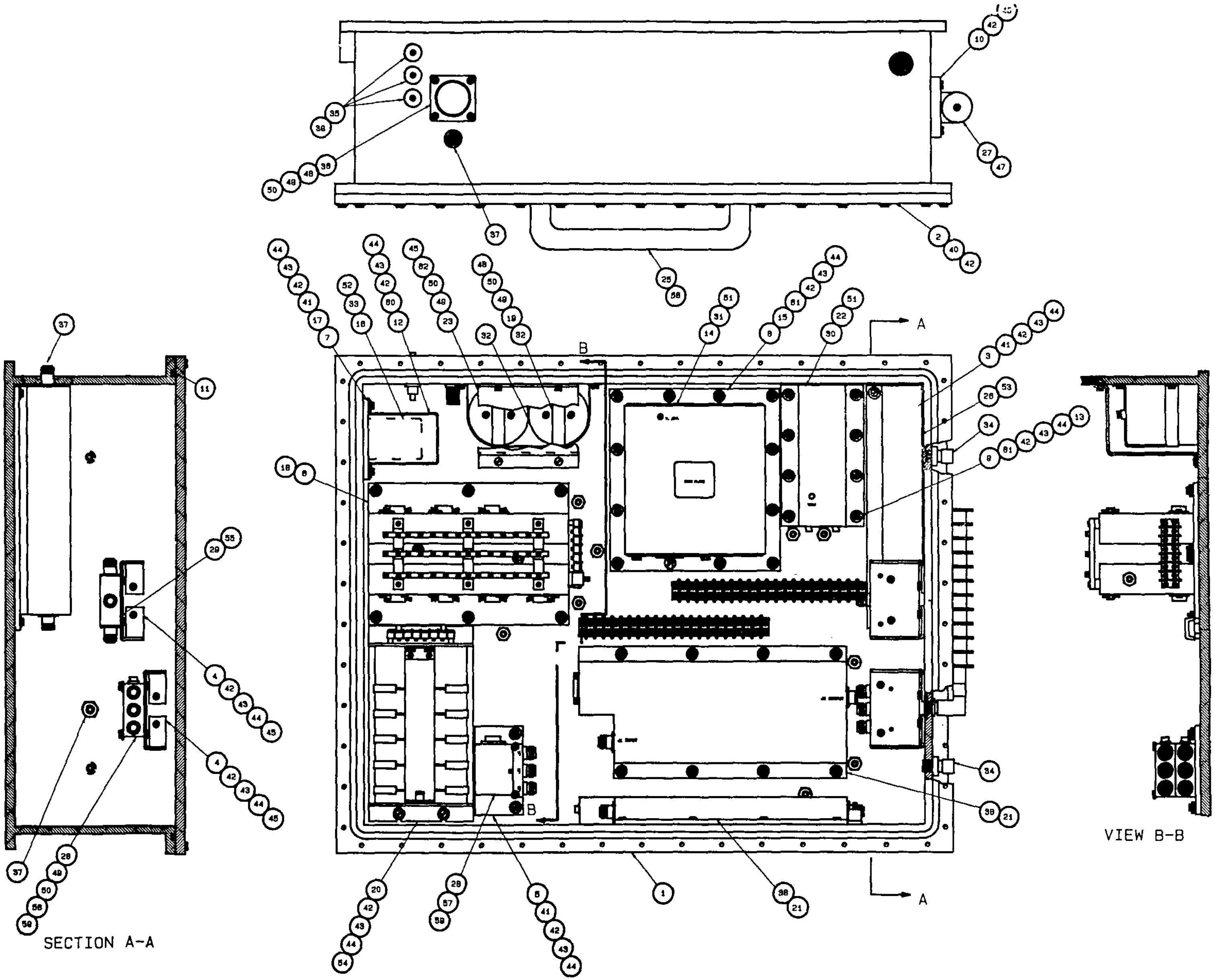


Fig. 1 — L-Band transmitter

	2	62				SCREW, PAN-HEAD, SLOTTED, #8-32UNC X .625	
	20	61		06540	6239-SS-1032	CAPTIVE PANEL SCREW	
	2	60		06540	6237-SS-1032	CAPTIVE PANEL SCREW	
	4	59			MS35649-284	NUT, HEX	
	4	58				SCREW, FLAT HEAD, SLOTTED, 82° .25X20 X .625	CRES
	2	57				SCREW, FLAT-HEAD, SLOTTED, 82° #8-32UNC X 2.50	
	2	56				SCREW, PAN-HEAD, SLOTTED, #8-32UNC X 1.375	
	2	55				SCREW, PAN-HEAD, SLOTTED, #6-32UNC X .375	
	4	54				SCREW, PAN-HEAD, SLOTTED, #10-32UNF X .500	
	4	53				SCREW, FLAT-HEAD, SLOTTED, 82° #10-32UNF X .50	
	6	52				SCREW, PAN-HEAD, SLOTTED, #8-32UNC X .250	
	8	51				SCREW, FLAT-HEAD, SLOTTED, 82° 25-28UNF X .750	CRES
	12	50			MS35338-137	WASHER, LOCK	
	12	49			MS15795-807	WASHER, FLAT	
	8	48				SCREW, PAN-HEAD, SLOTTED, #8-32UNC X .375	CRES
	4	47				SCREW, PAN-HEAD, SLOTTED, #8-32UNC X 1.00	
	4	46				SCREW, PAN-HEAD, SLOTTED, #10-32UNF X .750	
	6	45				SCREW, PAN-HEAD, SLOTTED, #10-32UNF X .625	CRES
	108	44			MS35338-138	WASHER, LOCK	
	108	43			MS15795-808	WASHER, FLAT	
	108	42		06540	2225-N194	NYLON WASHER, FLAT	
	108	41		06540	6238-SS-1032	CAPTIVE PANEL SCREW	
	54	40		06540	6240-SS-1032	CAPTIVE PANEL SCREW	
	3	39		75915		FUSE	
	2	38		50311	RF 1435C	SOLID STATE L-BAND POWER MODULE	
	2	37		77820	UG-30D/U	RF CONNECTOR	
	1	36		77820	MS3102E-32-8P	BOX-MOUNTING RECEPTACLE	
	3	35		75915	340 287	3AG PANEL FUSE HOLDER	
	2	34		02570	SS-600-1-OR	O-SEAL STRAIGHT THREAD CONNECTOR	
	1	33		05245	MODEL 10SP1A	POWER LINE FILTER	
	2	32		90201	CGS383U050X3L	CAPACITOR, 38000MFD, 50VDC	
	1	31		04971	MODEL 1405	1400 SERIES POWER SUPPLY	
	1	30		04971	MODEL 1101	1100 SERIES POWER SUPPLY	
	1	29			MODEL 311	CIRCULATOR	
	3	28		12598	MODEL S-3389	RF COAXIAL SWITCH	
	1	27		12598	MODEL T-2171	TERMINATION	
	1	26		50140	X8C42-1370/X20-N/N	NARROW BAND FILTER	
	2	25		51506	8578-A	HANDLE	
		24					
	1	23	D	81885		COVER, CAPACITOR	
	1	22	C	81995		GASKET, 1100 SERIES POWER SUPPLY	
	2	21	D			GASKET, POWER MODULE	
	1	20	D			CARD FILE, ASSEMBLY	
	1	19	C			STRAP, CAPACITOR	
	1	18	D			GASKET, MODULATOR/REGULATOR	
	1	17	C			GASKET, MOUNTING PLATE	
	1	16	C			GASKET, POWER LINE FILTER	
	1	15	D			GASKET, MOUNTING PLATE	
	1	14	D			GASKET, 1400 SERIES POWER SUPPLY	
	1	13	C			GASKET, MOUNTING PLATE	
	1	12	D			COVER, POWER LINE FILTER	
	1	11	D			O-RING	
	1	10	C			MOUNTING PLATE, TERMINATION	
	1	9	C			MOUNTING PLATE, 1100 SERIES POWER SUPPLY	
	1	8	D			MOUNTING PLATE, 1400 SERIES POWER SUPPLY	
	1	7	C			MOUNTING PLATE, POWER LINE FILTER	
	1	6	E			MODULATOR/REGULATOR ASSY	
	1	5	C			MOUNTING PLATE, RF COAXIAL SWITCH	
	2	4	C			BRACKET, RF COAXIAL SWITCH & CIRCULATOR	
	1	3	D			MOUNTING PLATE, NARROW BAND FILTER	
	1	2	E			COVER	
	1	1	E	81995		ENCLOSURE	

Fig. 2 — L-Band transmitter

Several mounting brackets and surfaces in the casing require a maximum waviness of 0.006 in. over a length of 4 in. This improves contact between heat-producing components, mounting brackets, and the casing. Improved surface tolerances are required on the modulator/regulator, power amplifiers, power supplies, and the RFI power filter mounting surfaces and brackets.

THERMAL DESIGN CONSIDERATIONS AND CONSTRAINTS

The thermal design of the transmitter allows effective operation during the worst case cycle time consisting of a period of 20 min on, followed by 20 min off. Coated with a low absorptivity-emissivity ratio paint, the exterior of the transmitter is designed to be cooled by natural convection. The ambient design condition consists of a sol-air temperature of 110°F (43°C) with zero wind speed. Interior heat is dissipated through passive design.

Components which generate heat, except the modulator/regulator assembly, have an upper operating temperature of 140°F (60°C). The modulator/regulator is limited by an upper temperature of 160°F (71°C). Thermostats, strategically located throughout the box, detect components that exceed maximum operating temperature and deactivate the power supplies for a minimum of 5 min.

The use of mounting brackets reduces the passive heat dissipation rate by decreasing the overall heat transfer coefficients. The decrease in heat transfer coefficents results from increased heat transfer path and additional contact resistance between surfaces (Fig. 3).

In place of silicone grease, a new thermal conductive product is being used to decrease contact resistance between mating surfaces. This product is a silicone elastomer binder with a thermal conductive filler that forms a flexible conductive pad which has a higher thermal conductivity than grease. The new thermal conductive product replaces silicone grease where modules require electrical isolation or high heat dissipation rates.

THERMAL DESIGN AND ANALYSIS APPROACH

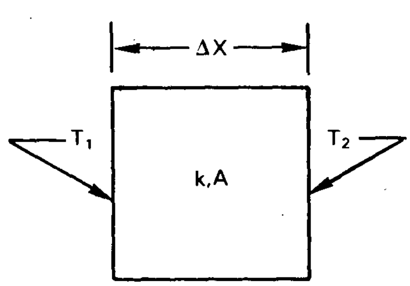
The L-band replacement transmitter is designed to improve the dissipation of heat. Heat dissipation, in turn, is improved by balancing the transfer of heat with short-term thermal storage, without exceeding component temperature limitations. Constraints on the design are large thermal gains over short periods of time, low-temperature gradient within the casing, and limited internal space.

Two design methods were analyzed to determine the most appropriate major form of heat dissipation for this design: the use of conduction heat transfer and thermal storage, and passive convection heat transfer using fin surfaces.

The following heat transfer and capacitance equations were used to evaluate the methods:

Conduction;

$$Q_k = -kA \frac{\Delta T}{\Delta x} \text{ (Btu/h)} \tag{1}$$



$$T_k = T_2 - T_1$$

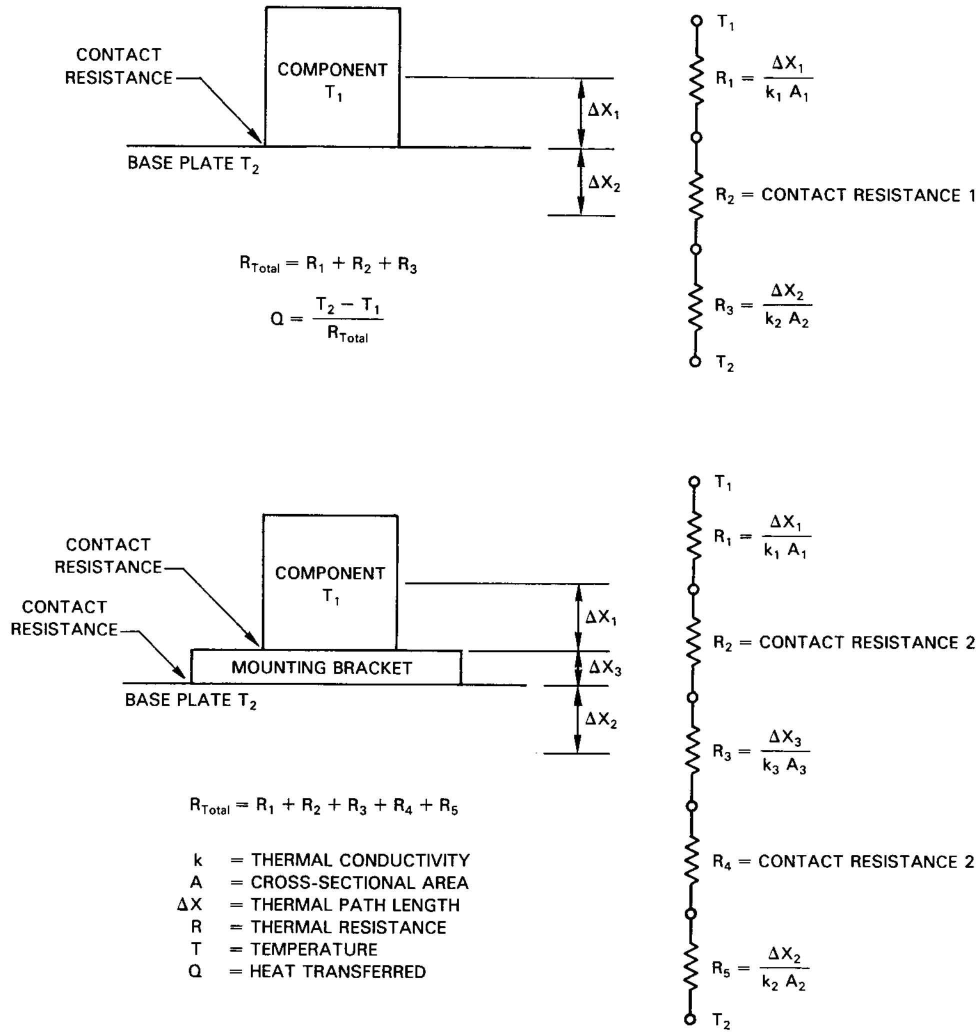
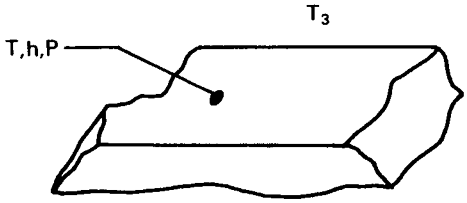


Fig. 3 — Effect of mounting brackets on total thermal resistance

Convection;

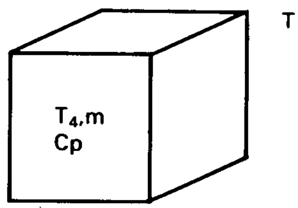
$$Q_h = hP\Delta T_h \text{ (Btu/h)} \tag{2}$$



$$\Delta T_h = T - T_3$$

Capacitance;

$$C = mC_p\Delta T_c \text{ (Btu)} \tag{3}$$



$$\Delta T_c = T_5 - T_4$$

where

k is the conductive heat transfer coefficient (Btu/h· ft · °F)
A is the cross-sectional area in the direction of heat flow (ft^2)
Δx is the heat transfer distance (ft)
ΔT_k is the temperature difference for heat transfer (°F).
h is the convective heat transfer coefficient (Btu/h · ft ^{2} °F)
P is the heat transfer surface area or perimeter (ft^2)
ΔT_h is the temperature difference for heat transfer (°F)
m is the mass (lbm)
C_p is the specific heat (BTM/lbm · °F)
ΔT_c is the temperature difference for thermal storage (°F).

For this design, k,h, and C_p are fixed, and the temperature differences ΔT_k, ΔT_h, and ΔT_c are relatively small. The only coefficients which can be varied to improve heat transfer and storage are A, Δx, P, and m. An increase in A and decrease in Δx improves heat conduction by enlarging the contact area and decreasing the heat transfer path. Increasing P improves convection by increasig the surface area. Increasing m improves the thermal storage capability.

Finned surfaces are recommended when convective heat transfer is the limiting factor in the total dissipation of heat and when 2/k (b · h) > 5, where b is the fin thickness (Fig. 4). Fins are added to the surface P to increase the overall surface area until an optimum solution is reached, where the convective and conductive heat transfer rates are balanced:

$$kA \frac{\Delta T_k}{\Delta x} = hP\ T_h. \tag{4}$$

For this design, the convective heat transfer rate needs to be at least equivalent to conductive heat transfer rate to the baseplate to be the more attractive solution.

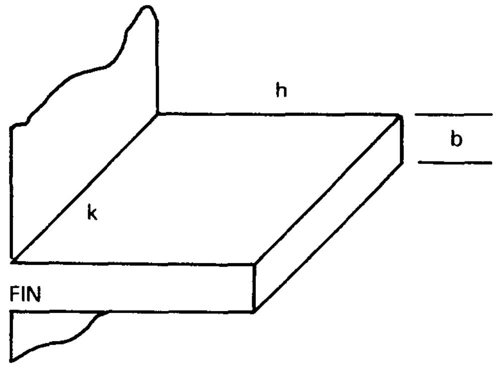


Fig. 4 — Fin surface

The value for ΔT_k and ΔT_h are approximately equal and can be eliminated from the equation. After rearranging terms, the equation for the required convective heat transfer surface, P, becomes:

$$P = \frac{kA}{h\Delta x}. \tag{5}$$

Using the conductive coefficient values for the modulator/regulator,

$$\frac{kA}{\Delta X} = 8.9 \frac{\text{Btu}}{h\ °F}$$

and the convective heat transfer coefficient,

$$h = 0.4 \frac{\text{Btu}}{h\ °F \cdot ft^2}.$$

To calculate the required surface area for equivalent heat transfer, P is equal to 22.25 ft^2. The present surface area is 2.06 ft^2; thus P requires 10.8 times more surface area. With internal space at a premium, the use of fin surfaces as the major form of heat transfer is prohibitive. Fins are used as a secondary source for additional cooling on particular components.

In developing thermal models there are two standard approaches to handling purchased components. The first is to introduce the component as a heat source applied to a surface; the second is to incorporate the component as a physical part of the model. The first approach assumes that the component is not critical to the operation of the design, or that the possibility of thermal failure from this component is minute. The second approach assumes the opposite. This second approach was used throughout the analysis.

Accurate incorporation of component into the system requires the use of detailed manufacturer information. Where manufacturer information was not available or did not exist, visual inspection and available data were used to estimate heat transfer coefficient and capacitance.

THERMAL COMPUTER PROGRAMS

Two main computer programs were used to analyze the thermal characteristics of the transmitter: Radiation View Factor (RAVFAC) and System Improved Numerical Differencing Analyzer (SINDA). These programs were developed for NASA by Lockheed and TRW Corporations, respectively, to analyze space flight equipment. Currently, both programs are recognized and used within the aerospace industry. The programs use finite difference, contour integrals, and other matrix techniques to formulate thermal and general solutions.

RAVFAC develops the blackbody radiation view factor, f_{ij}, to determine radiation exchange between objects. Radiation view factor is defined as the percent of radiation emitted by surface i that impinges on surface j (Fig. 5). The accuracy of the results are dependent on the number of elements per node and nodes per surface, and the distance between the two surfaces, i and j, relative to the size of the surfaces.

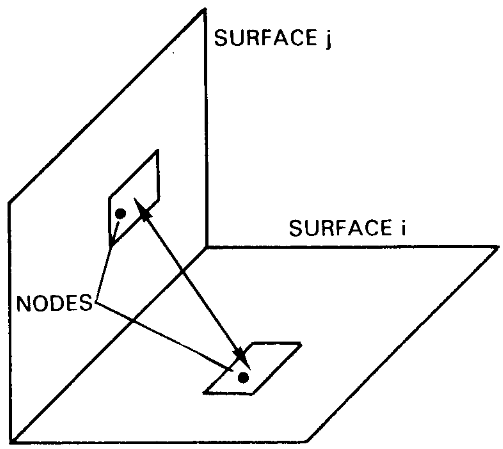


Fig. 5 — Radiation exchange

SINDA uses a resistor-capacitor (R-C) network to represent a thermal system. Each component is represented as a nodal point (s), interconnected to other nodal points by resistors, i.e., conduction, convection, and radiation conductance (Fig. 6). Associated with each node is a thermal capacitance for energy storage. The accuracy of the results are dependent on the number of nodal points used to describe a component and by the accuracy of the heat transfer coefficient and thermal capacitance.

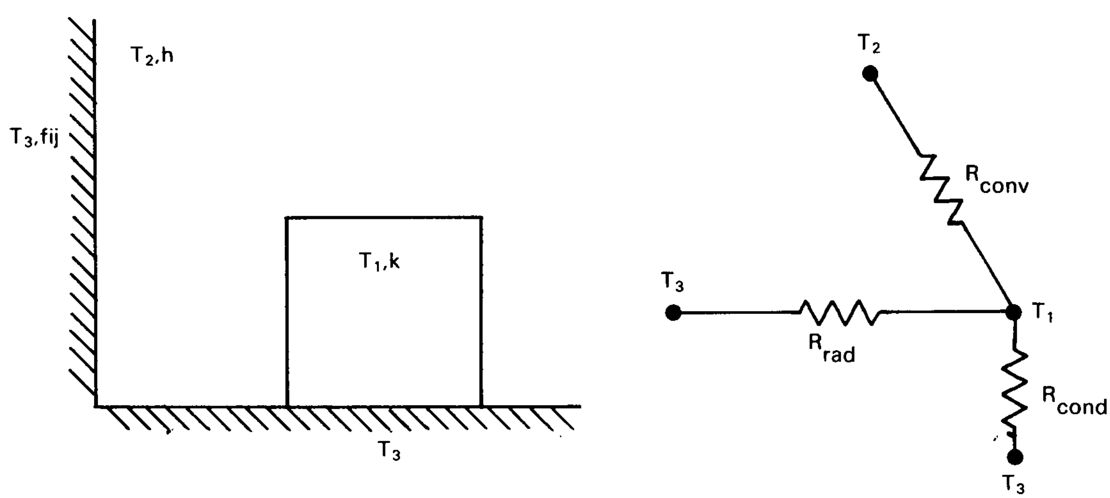


Fig. 6 — R-C network

Several other computer programs are required to generate view factors and to arrange them into a format acceptable to SINDA: Ravplot-three-dimensional plotting program, Copaps-data reduction program, and Script f-data conversion program.

THERMAL MODEL DEVELOPMENT

The RAVFAC data deck for this model is constructed of two-dimensional rectangular and circular plates, and three-dimensional cylinders. Rectangular components are made up of six rectangular plates to represent the six sides of a box. The capacitors are the only nonrectangular components and are constructed by combining a cylinder with two circular plates. Flat objects such as printed circuit boards are constructed of two rectangular plates facing opposite directions. The walls of the casing are made up of rectangular plates facing into the casing. Appendix A includes a RAVFAC deck.

Each plate is constructed of one node which is subdivided into rectangular elements with the length of each element varying from 1 to 2 in. on a side.

The plotting program Ravplot is used to assure correct orientation of surfaces and components before RAVFAC is executed. Figures 7 and 8 are examples of Ravplot drawings. Appendix B includes Ravplot deck.

The execution of RAVFAC generates view factors for each surface, i.e., six sets of view factors for each box. The program Colaps is used to reduce the data to a more manageable form. Colaps reduces sets of view factors to a single set, i.e., each component becomes a single set. Appendix C shows a Colaps deck.

Script f uses surface emissivities, the blackbody view factor and area data from Colaps to generate greybody conductance values. Appendix D includes a Script F data deck.

SINDA requires capacitance, conductor, and source data to generate steady state or transient temperatures profiles. Appendix E includes a complete SINDA data deck.

The capacitance (thermal storage) C is specified in units of Btu per °F and is calculated by using either Eq. (6) or (7). The capacitance values are located in the Node Data block.

$$C = mC_p \tag{6}$$

$$C = VC_p \tag{7}$$

where

C is the capacitance	(Btu/°F)
m is the mass	(lbm)
C_p is the specific heat	(Btu/lbm ·°F)
ρ is the density	(lbm/ft^3)
V is the volume	(ft^3).

The conductance uses the format of Eq. (8). The convective and conductive conductors are input as linear conductors into the network solution using Eqs. (9) and (10), respectively.

$$\dot{Q} = G \cdot (T2 - T1) \tag{8}$$

where

$\dot{Q}$ is the heat rate	(Btu/h)
G is the conductance	(Btu/h · °F)
T is the temperature	(°F)

$$G = h \cdot P \tag{9}$$

$$G = k \cdot \frac{A}{x} \tag{10}$$

where

h is the convective film coefficient (Btu/ft^2· h · °F)
P is the surface area (ft^2)
k is the thermal conductivity of the material (Btu/ft · h · °F)
A is the cross-sectional area of the conductive (ft^2)
x is the length of the conductive path (ft).

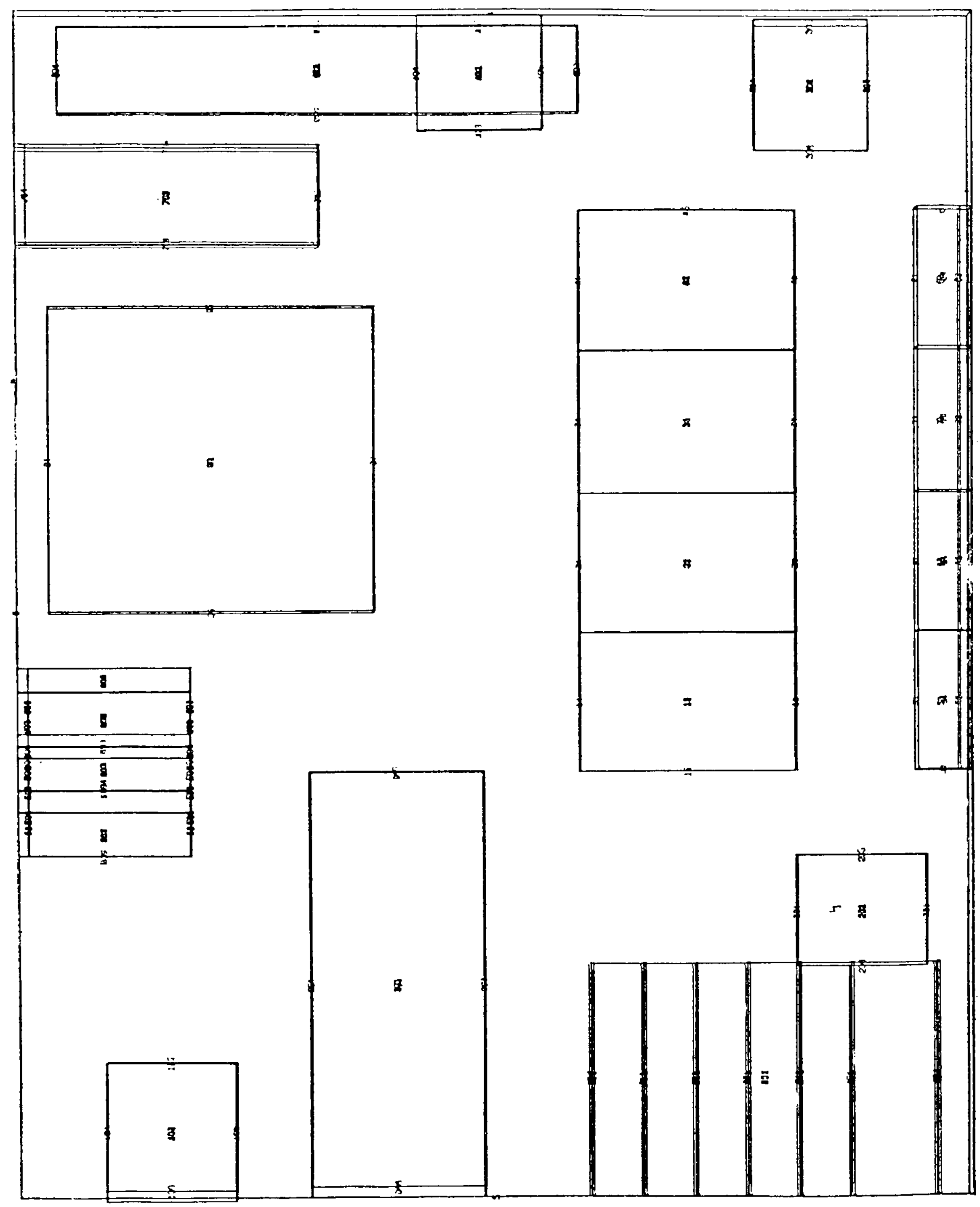


Fig. 7 — RAVPLOT of L-band transmitter

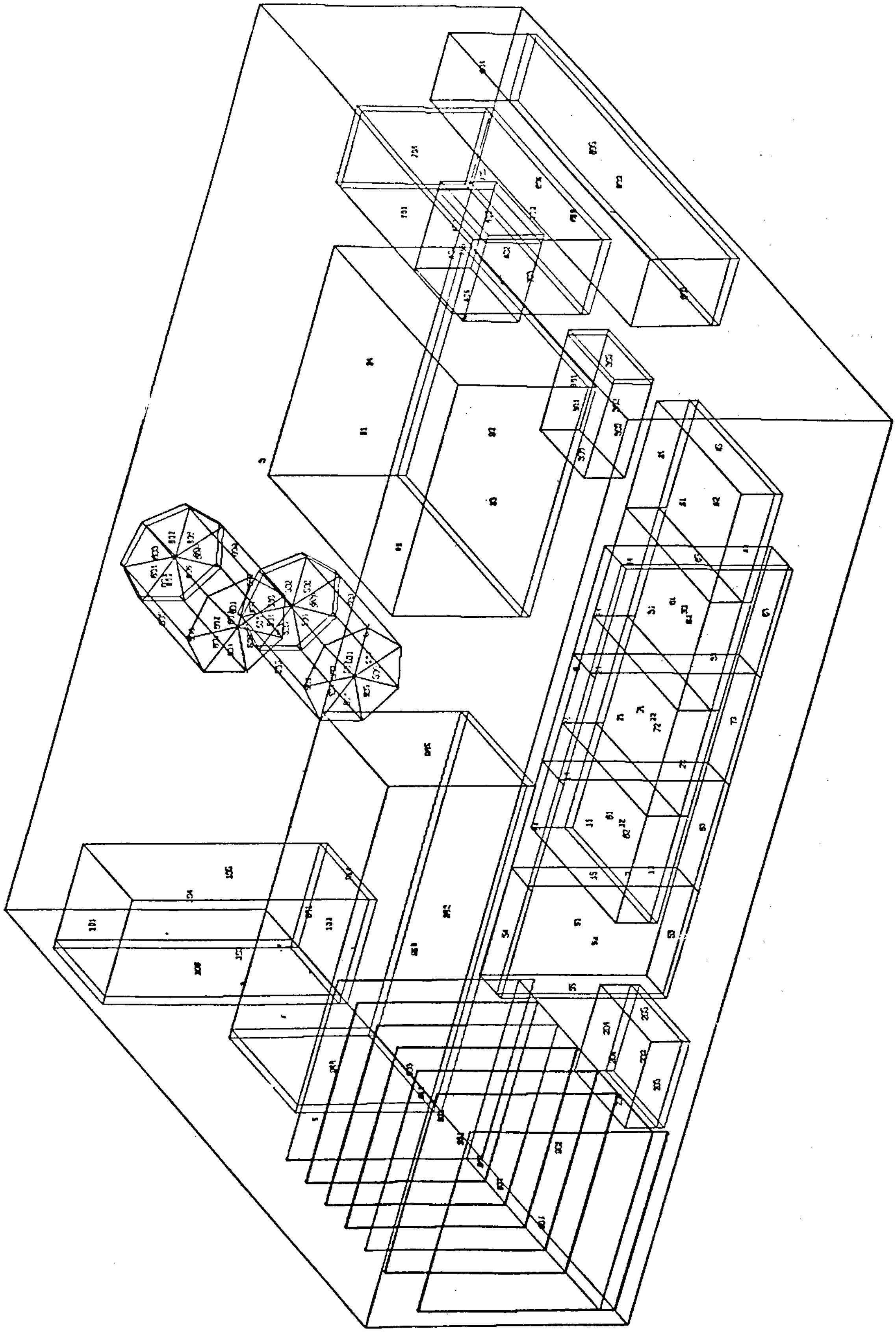


Fig. 8 — RAVPLOT of L-band transmitter

To account for contact resistance between surfaces where the conductive pad is used, the contact area is assumed to be half the plate area. Where the pad is not used, the mounting screw area is assumed to be the contact area.

The radiation conductor is input as a nonlinear conductor using the format of Eq. (11).

$$G = \epsilon\sigma\ FA\,((T + 460))\ ((T\ 460)^2 + (T + 460)^2) \tag{11}$$

where

σ is the Stefan-Boltzman constant 0.1714×10^{-8} (Btu/ft$^2\dot{c}$ h $\cdot$ R^4)
ϵ is the emissivity
FA is Script f (ft^2).

The conductors are located in the Conductor Data block.

Heat sources are redefined in each iteration of the analysis. The heat source values are listed in the Constants Data block and redefined in the Variables 1 block.

Time between iterations is 0.5 min with output every 5 min. The cycle time for the first 250 min is 5 min on, followed by 20 min off to stabilize the transmitter cycle temperature. This is followed by a 20 min on, 20 min off worst condition cycle. The final 150 min returns to the original 5 min on, 20 min off cycle. The cycle scheduling is listed in the Execution block.

OBSERVATIONS AND DESIGN MODIFICATIONS

Preliminary results revealed one major and two minor localized hot spots, and three areas of concern with insufficient manufacturer's data.

The modulator/regulator is the most likely component to exceed its temperature limit. Heat is difficult to dissipate due to the small surface area relative to the amount of heat generated by the regulator. A high thermal resistance also exists between the interior of the regulator and its conducting surface. To utilize the available surface area, the regulators are attached to large aluminum blocks. In addition, each regulator is finned for additional heat dissipation. The size and shape of the heat sink/mounting bracket was determined by the available space within the casing (Fig. 9).

The output sections of the power amplifiers are minor areas of concern. The analysis shows that the amplifiers approach their maximum temperature limits as the modulator/regulator reaches its limit. There is sufficient temperature gradient difference between the amplifiers and their limit to allow the modulator/regulator to deactivate the power supplies before the amplifiers reach their maximum temperature. Therefore, no revisions were required in the design.

The three areas of possible concern due to insufficient manufacturer's data were the two power supplies and the RFI power filter. The analysis indicated the three components are operating below their respective critical temperature limits, but due to limited manufacturer's data, the coefficients are of questionable value. The smaller of the two power supplies was opened for visual inspection, and all heat generating components appeared to be well heat sunk. When the unit was bench-tested, it appeared to operate near ambient conditions. The power supplies arrived from the manufacturer with a label requesting adequate heat sinking. To assure proper operation of the two supplies, the mounting bracket thickness was increased to a half inch instead of the quarter inch used on all other brackets.

The RFI power filter is hermetically sealed, which eliminates visual inspection, and requires the manufacturer's limited information be used to calculate the coefficients. The filter was bench-tested and appeared to remain cool. Due to the high electrical efficiency of the filter, the mounting bracket will follow the design of other components until a full-scale test of the transmitter is conducted.

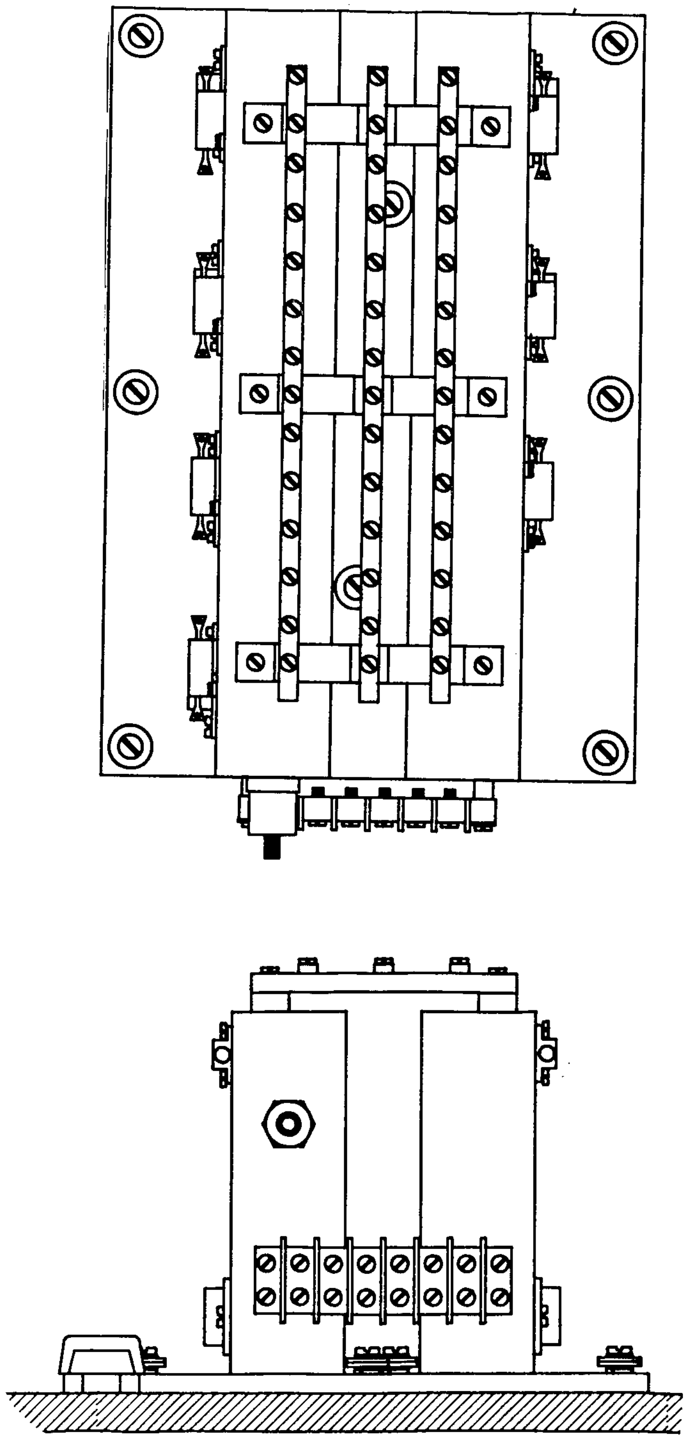


Fig. 9 — Modulator/regulator

CONCLUSION

The thermal analysis predicts that the transmitter is capable of withstanding an ambient sol-air temperature of 110°F (43°C), with no wind, and will operate effectively. The transmitter is also able to withstand extreme environmental conditions without malfunctioning.

During normal operations the interior of the transmitter is designed to minimize component temperature rise. This is accomplished by spreading out the heat generated by the components into the mounting bracket/heat sink. Lower temperature rise will increase the life expectancy of the electronic components.

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Appendix A

RAVFAC

```
/ JOB BENNETT,77G126P4,BENNT2,OPT=(C,R),CAT=23
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/ FD FT06F001.BAND=5/40/5
/ FD FT07F001,BAND=5/50/5
/ FD FT09F001,BAND=5/55/5
/ ASG LRAVFAC,MY/RAVFAC/LRAVFAC,USE=SHR
/ EXQT GO=LRAVFAC,CPTIME=800000,OPT=(7,A)
 L BAND 1 TRANSMITTER RADIATION ANALYSIS
   1     0     2     2                                              2    -1
  10133                                                     RFI POWER FILTER TOP
        1     1     1     2     30.0        0.0        7.5         0.0         3.1875
        0            0.0         0.75       6.0        0.0         0.0         0.0
  10233                                                     RFI POWER FILTER BOTTOM
       -1     1     1     2     30.0        0.0        7.5         0.0         3.1875
        0            0.0         0.75       3.5        0.0         0.0         0.0
  10333                                                     RFI POWER FILTER FRONT
       -1     1     1     2     30.0        0.0        7.5         0.0         2.5
        0            3.1875      0.75       3.5        0.0         90.0        0.0
  10433                                                     RFI POWER FILTER BACK
        1     1     1     2     30.0        0.0        7.5         0.0         2.5
        0            0.25        0.75       3.5        0.0         90.0        0.0
  10533                                                     RFI POWER FILTER RIGHT SIDE
       -1     1     1     2     20.0        0.0        2.5         0.0         3.1875
        0            0.0         8.25       3.5        0.0         0.0         90.0
  10633                                                     RFI POWER FILTER LEFT SIDE
        1     1     1     2     20.0        0.0        2.5         0.0         3.1875
        0            0.0         0.75       3.5        0.0         0.0         90.0
  20133                                                     COAX SWITCH 1 TOP
        1     1     1     2     20.0        0.0        2.625       0.0         3.015
        0            18.0        6.25       1.1875     0.0         0.0         0.0
  20233                                                     COAX SWITCH 1 BOTTOM
       -1     1     1     2     20.0        0.0        2.625       0.0         3.015
        0            18.0        6.25       0.25       0.0         0.0         0.0
  20333                                                     COAX SWITCH 1 FRONT
       -1     1     1     2     10.0        0.0        2.625       0.0         1.1875
        0            21.015      6.25       0.0        0.0         90.0        0.0
  20433                                                     COAX SWITCH 1 BACK
        1     1     1     2     10.0        0.0        2.625       0.0         1.1875
        0            18.0        6.25       0.0         0.0         90.0       0.0
  20533                                                     COAX SWITCH 1 RIGHT SIDE
       -1     1     1     1     20.0        0.0        1.1875        0.0       3.015
        0            18.0        8.875      0.0        0.0           0.0       90.0
  20633                                                     COAX SWITCH 1 LEFT SIDE
        1     1     1     1     20.0        0.0        1.1875      0.0         3.015
        0            18.0        6.25       0.0        0.0         0.0         90.0
  30133                                                     COAX SWITCH 2 TOP
        1     1     1     2     20.0        0.0        3.015       0.0         2.625
        0            17.0        24.385     5.1875     0.0         0.0         0.0
  30233                                                     COAX SWITCH 2 BOTTOM
       -1     1     1     2     20.0        0.0        3.015       0.0         2.625
        0            17.0        24.385     4.0        0.0         0.0         0.0
  30333                                                     COAX SWITCH 2 FRONT
       -1     1     1     2     10.0        0.0        3.015       0.0         1.1875
        0            19.625      24.385     4.0        0.0         90.0        0.0
  30433                                                     COAX SWITCH 2 BACK
        1     1     1     2     10.0        0.0        3.015       0.0         1.1875
        0            17.0        24.385     4.0        0.0         90.0        0.0
  30533                                                     COAX SWITCH 2 RIGHT SIDE
       -1     1     1     1     20.0        0.0        1.1875      0.0         2.625
        0            17.0        27.25      4.0        0.0         0.0         90.0
  30633                                                     COAX SWITCH 2 LEFT SIDE
        1     1     1     1     20.0        0.0        1.1875      0.0         2.625
        0            17.0        24.385     4.0        0.0         0.0         90.0
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40133                                                  CIRCULATOR TOP
      1     1     1    2     20.0       0.0            2.625      0.0        2.875
      0            9.25      24.875     5.1875         0.0        0.0        0.0
40233                                                  CIRCULATOR BOTTOM
     -1     1     1    2     20.0       0.0            2.625      0.0        2.875
      0            9.25      24.875     3.5            0.0        0.0        0.0
40333                                                  CIRCULATOR FRONT
     -1     1     1    2     10.0       0.0            2.625      0.0        1.6875
      0           12.125     24.875     3.5            0.0        90.0       0.0
40433                                                  CIRCULATOR BACK
      1     1     1    2     10.0       0.0            2.625      0.0        1.6875
      0            9.25      24.875     3.5            0.0        90.0       0.0
40533                                                  CIRCULATOR RIGHT SIDE
     -1     1     1    1     20.0       0.0            1.6875     0.0        2.875
      0            9.25      27.25      3.5            0.0        0.0        90.0
40633                                                  CIRCULATOR LEFT SIDE
      1     1     1    1     20.0       0.0            1.6875     0.0        2.875
      0            9.25      24.875     3.5            0.0        0.0        90.
50133                                                  CAPACITOR 1 TOP
      2     1     7    2     10.0       0.0            1.5        0.1        360.0
      0            5.25      3.00       4.0            0.0        0.0        0.0
50233                                                  CAPACITOR 1 BOTTOM
     -2     1     7    2     10.0       0.0            1.5        0.1        360.0
      0            5.25      3.00       0.250          0.0        0.0        0.0
50333                                                  CAPACITOR 1 SIDE
      4     1     7    2     31.5       0.0            4.0        0.1        360.0
      0            5.25      3.00       0.0            0.0        0.0        0.0
60133                                                  CAPACITOR 2 TOP
      2     1     7    2     10.0       0.0            1.5        0.1        360.0
      0            5.25      6.50       4.0            0.0        0.0        0.0
60233                                                  CAPACITOR 2 BOTTOM
     -2     1     7    2     10.0       0.0            1.5        0.1        360.0
      0            5.25      6.50       0.250          0.0        0.0        0.0
60333                                                  CAPACITOR 2 SIDE
      4     1     7    2     31.5       0.0            4.0        0.1        360.0
      0            5.25      6.50       0.0            0.0        0.0        0.0
70133                                                  POWER SUPPLY 1100 TOP
      1     1     1    2     30.0       0.0            2.25       0.0        7.0
      0            9.25      18.25      4.1875         90.0       0.0        0.0
70233                                                  POWER SUPPLY 1100 BOTTOM
     -1     1     1    2     30.0       0.0            2.25       0.0        7.0
      0            9.25      18.25      0.25           90.0       0.0        0.0
70333                                                  POWER SUPPLY 1100 FRONT
     -1     1     1    2     40.0       0.0            2.25       0.0        4.1875
      0            9.25      11.25      0.0            90.0       90.0       0.0
70433                                                  POWER SUPPLY 1100 BACK
      1     1     1    2     40.0       0.0            2.25       0.0        4.1875
      0            9.25      18.25      0.0            90.0       90.0       0.0
70533                                                  POWER SUPPLY 1100 RIGHT SIDE
     -1     1     1    1     30.0       0.0            4.1875     0.0        7.0
      0           11.5       18.25      0.0            90.0       0.0        90.0
70633                                                  POWER SUPPLY 1100 LEFT SIDE
      1     1     1    1     30.0       0.0            4.1875     0.0        7.0
      0            9.25      18.25      0.0            90.0       0.0        90.0
80133                                                  FILTER TOP
      1     1     1    1     60.0       0.0            2.5        0.0        12.125
      0            0.0       25.0       2.6875         0.0        0.0        0.0
80233                                                  FILTER BOTTOM
     -1     1     1    1     60.0       0.0            2.25       0.0        11.875
      0            0.25      25.0       0.250          0.0        0.0        0.0
80333                                                  FILTER FRONT
     -1     1     1    2     20.0       0.0            2.5        0.0        2.6875
      0           12.125     25.0       0.0            0.0        90.0       0.0
80433                                                  FILTER BACK
      1     1     1    2     20.0       0.0            2.25       0.0        2.6875
      0            0.250     25.0       0.0            0.0        90.0       0.0
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80533                                                  FILTER RIGHT SIDE
     -1    1    1    1      60.0        0.0            2.6875      0.0          12.125
      0         0.0         27.25       0.0            0.0         0.0          90.0
80633                                                  FILTER LEFT SIDE
      1    1    1    1      60.0        0.0            2.6875      0.0          12.125
      0         0.0         25.0        0.0            0.0         0.0          90.0
90133                                                  CARD BUCKET BOTTOM DOWN
     -1    1    1    6      30.0        0.0            8.0         0.0          5.5
      0         13.25       5.5         0.48           90.0        0.0          0.0
90233                                                  CARD BUCKET BOTTOM UP
      1    1    1    6      30.0        0.0            8.0         0.0          5.5
      0         13.25       5.5         0.49           90.0        0.0          0.0
90333                                                  CARD BUCKET RIGHT SIDE OUT
     -1    1    1    3      30.0        0.0            6.0         0.0          5.5
      0         21.25       5.5         0.0            90.0        0.0          90.0
90433                                                  CARD BUCKET RIGHT SIDE IN
      1    1    1    3      30.0        0.0            6.0         0.0          5.5
      0         21.2        5.5         0.0            90.0        0.0          90.0
90533                                                  CARD BUCKET LEFT SIDE OUT
      1    1    1    3      30.0        0.0            6.0         0.0          5.5
      0         13.2        5.5         0.0            90.0        0.0          90.0
90633                                                  CARD BUCKET LEFT SIDE IN
     -1    1    1    3      30.0        0.0            6.0         0.0          5.5
      0         13.25       5.5         0.0            90.0        0.0          90.0
91133                                                  CARD 1 LEFT FACE
      1    1    1    3      30.0        0.0            5.5         0.0          5.5
      0         14.4        5.5         0.5            90.0        0.0          90.0
91233                                                  CARD 1 RIGHT FACE
     -1    1    1    3      30.0        0.0            5.5         0.0          5.5
      0         14.45       5.5         0.5            90.0        0.0          90.
92133                                                  CARD 2 LEFT FACE
      1    1    1    3      30.0        0.0            5.5         0.0          5.5
      0         15.6        5.5         0.5            90.0        0.0          90.
92233                                                  CARD 2 RIGHT FACE
     -1    1    1    3      30.0        0.0            5.5         0.0          5.5
      0         15.65       5.5         0.5            90.0        0.0          90.
93133                                                  CARD 3 LEFT FACE
      1    1    1    3      30.0        0.0            5.5         0.0          5.5
      0         16.8        5.5         0.5            90.0        0.0          90.
93233                                                  CARD 3 RIGHT FACE
     -1    1    1    3      30.0        0.0            5.5         0.0          5.5
      0         16.85       5.5         0.5            90.0        0.0          90.
94133                                                  CARD 4 LEFT FACE
      1    1    1    3      30.0        0.0            5.5         0.0          5.5
      0         18.0        5.5         0.5            90.0        0.0          90.0
94233                                                  CARD 4 RIGHT FACE
     -1    1    1    3      30.0        0.0            5.5         0.0          5.5
      0         18.05       5.5         0.5            90.0        0.0          90.
95133                                                  CARD 5 LEFT FACE
      1    1    1    3      30.0        0.0            5.5         0.0          5.5
      0         19.2        5.5         0.5            90.0        0.0          90.
95233                                                  CARD 5 RIGHT FACE
     -1    1    1    3      30.0        0.0            5.5         0.0          5.5
      0         19.25       5.5         0.5            90.0        0.0          90.
96133                                                  REGULATOR TOP
      1    1    1    1      30.0        0.0            0.75        0.0          5.5
      0         6.5         0.0         6.0            0.0         0.0          0.0
96333                                                  REGULATOR FRONT
     -1    1    1    1      30.0        0.0            0.75        0.0          6.0
      0         12.0        0.0         0.0            0.0         90.0         0.0
96433                                                  REGULATOR BACK
      1    1    1    1      30.0        0.0            0.75        0.0          6.0
      0         6.5         0.0         0.0            0.0         90.0         0.0
96533                                                  REGULATOR RIGHT SIDE
     -1    1    1    3      30.0        0.0            6.0         0.0          5.5
      0         6.5         0.75        0.0            0.0         0.0          90.0
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96633							REGULATOR LEFT SIDE		
	1	1	1	3	30.0	0.0	5.75	0.0	5.5
	0		6.5		0.25	0.25	0.0	0.0	90.0
1133							AMP 1 TOP #1		
	1	1	1	2	30.0	0.0	3.25	0.0	5.0
	0		13.0		10.0	1.25	0.0	0.0	0.0
1233							AMP 1 BOTTOM #1		
	-1	1	1	2	30.0	0.0	3.25	0.0	5.0
	0		13.0		10.0	0.250	0.0	0.0	0.0
1333							AMP 1 FRONT #1		
	-1	1	1	2	10.0	0.0	3.25	0.0	1.25
	0		18.0		10.0	0.0	0.0	90.0	0.0
1433							AMP 1 BACK #1		
	1	1	1	2	10.0	0.0	3.25	0.0	1.25
	0		13.0		10.0	0.0	0.0	90.0	0.0
1533							AMP 1 LEFT SIDE #1		
	1	1	1	1	30.0	0.0	1.25	0.0	5.0
	0		13.0		10.0	0.0	0.0	0.0	90.
2133							AMP 1 TOP #2		
	1	1	1	2	30.0	0.0	3.25	0.0	5.0
	0		13.0		13.25	1.25	0.0	0.0	0.0
2233							AMP 1 BOTTOM #2		
	-1	1	1	2	30.0	0.0	3.25	0.0	5.0
	0		13.0		13.25	0.250	0.0	0.0	0.0
2333							AMP 1 FRONT #2		
	-1	1	1	2	10.0	0.0	3.25	0.0	1.25
	0		18.0		13.25	0.0	0.0	90.0	0.0
2433							AMP 1 BACK #2		
	1	1	1	2	10.0	0.0	3.25	0.0	1.25
	0		13.0		13.25	0.0	0.0	90.0	0.0
3133							AMP 1 TOP #3		
	1	1	1	2	30.0	0.0	3.25	0.0	5.0
	0		13.0		16.5	1.25	0.0	0.0	0.0
3233							AMP 1 BOTTOM #3		
	-1	1	1	2	30.0	0.0	3.25	0.0	5.0
	0		13.0		16.5	0.250	0.0	0.0	0.0
3333							AMP 1 FRONT #3		
	-1	1	1	2	10.0	0.0	3.25	0.0	1.25
	0		18.0		16.5	0.0	0.0	90.0	0.0
3433							AMP 1 BACK #3		
	1	1	1	2	10.0	0.0	3.25	0.0	1.25
	0		13.0		16.5	0.0	0.0	90.0	0.0
4133							AMP 1 TOP #4		
	1	1	1	2	30.0	0.0	3.25	0.0	5.0
	0		13.0		19.75	1.25	0.0	0.0	0.0
4233							AMP 1 BOTTOM #4		
	-1	1	1	2	30.0	0.0	3.25	0.0	5.0
	0		13.0		19.75	0.250	0.0	0.0	0.0
4333							AMP 1 FRONT #4		
	-1	1	1	2	10.0	0.0	3.25	0.0	1.25
	0		18.0		19.75	0.0	0.0	90.0	0.0
4433							AMP 1 BACK #4		
	1	1	1	2	10.0	0.0	3.25	0.0	1.25
	0		13.0		19.75	0.0	0.0	90.0	0.0
4533							AMP 1 RIGHT SIDE #4		
	-1	1	1	1	30.0	0.0	1.25	0.0	5.0
	0		13.0		23.00	0.0	0.0	0.0	90.0
5133							AMP 2 TOP #1		
	1	1	1	2	30.0	0.0	3.25	0.0	5.0
	0		20.75		10.0	0.75	0.0	90.0	0.0
5233							AMP 2 BOTTOM #1		
	-1	1	1	2	30.0	0.0	3.25	0.0	5.0
	0		21.75		10.0	0.75	0.0	90.0	0.0
5333							AMP 2 FRONT #1		
	-1	1	1	2	10.0	0.0	3.25	0.0	1.25
	0		20.75		10.0	0.75	0.0	0.0	0.0

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5433                                            AMP 2 BACK #1
      1    1    1   2     10.0        0.0       3.25       0.0        1.25
      0         20.75     10.0        5.75      0.0        0.0        0.0
5533                                            AMP 2 LEFT SIDE #1
     -1    1    1   1     30.0        0.0       1.25       0.0        5.0
      0         20.75     10.0        0.75      90.0       90.0       0.0
6133                                            AMP 2 TOP #2
      1    1    1   2     30.0        0.0       3.25       0.0        5.0
      0         20.75     13.25       0.75      0.0        90.0       0.0
6233                                            AMP 2 BOTTOM #2
     -1    1    1   2     30.0        0.0       3.25       0.0        5.0
      0         21.75     13.25       0.75      0.0        90.0       0.0
6333                                            AMP 2 FRONT #2
     -1    1    1   2     10.0        0.0       3.25       0.0        1.25
      0         20.75     13.25       0.75      0.0        0.0        0.0
6433                                            AMP 2 BACK #2
      1    1    1   2     10.0        0.0       3.25       0.0        1.25
      0         20.75     13.25       5.75      0.0        0.0        0.0
7133                                            AMP 2 TOP #3
      1    1    1   2     30.0        0.0       3.25       0.0        5.0
      0         20.75     16.5        0.75      0.0        90.0       0.0
7233                                            AMP 2 BOTTOM #3
     -1    1    1   2     30.0        0.0       3.25       0.0        5.0
      0         21.75     16.5        0.75      0.0        90.0       0.0
7333                                            AMP 2 FRONT #3
     -1    1    1   2     10.0        0.0       3.25       0.0        1.25
      0         20.75     16.5        0.75      0.0        0.0        0.0
7433                                            AMP 2 BACK #3
      1    1    1   2     10.0        0.0       3.25       0.0        1.25
      0         20.75     16.5        5.75      0.0        0.0        0.0
8133                                            AMP 2 TOP #4
      1    1    1   2     30.0        0.0       3.25       0.0        5.0
      0         20.75     19.75       0.75      0.0        90.0       0.0
8233                                            AMP 2 BOTTOM #4
     -1    1    1   2     30.0        0.0       3.25       0.0        5.0
      0         21.75     19.75       0.75      0.0        90.0       0.0
8333                                            AMP 2 FRONT #4
     -1    1    1   2     10.0        0.0       3.25       0.0        1.25
      0         20.75     19.75       0.75      0.0        0.0        0.0
8433                                            AMP 2 BACK #4
      1    1    1   2     10.0        0.0       3.25       0.0        1.25
      0         20.75     19.75       5.75      0.0        0.0        0.0
8533                                            AMP 2 RIGHT SIDE #4
      1    1    1   1     30.0        0.0       1.25       0.0        5.0
      0         20.75     23.00       0.75      90.0       90.0       0.0
9133                                          - POWER SUPPLY 1400 TOP
      1    1    1   3     50.0        0.0       7.0        0.0        11.0
      0         0.750     23.0        4.1875    90.        0.0        0.0
9233                                            POWER SUPPLY 1400 BOTTOM
     -1    1    1   3     50.0        0.0       7.0        0.0        11.
      0         0.750     23.0        0.250     90.0       0.0        0.0
9333                                            POWER SUPPLY 1400 FRONT
     -1    1    1   3     20.0        0.0       7.0        0.0        4.1875
      0         0.750     23.0        0.0       90.0       90.0       0.0
9433                                            POWER SUPPLY 1400 BACK
      1    1    1   3     20.0        0.0       7.0        0.0        4.1875
      0         0.750     12.0        0.0       90.0       90.0       0.0
9533                                            POWER SUPPLY 1400 RIGHT SIDE
     -1    1    1   2     50.0        0.0       4.1875     0.0        11.
      0         0.750     23.0        0.0       90.0       0.0        90.0
9633                                            POWER SUPPLY 1400 LEFT SIDE
      1    1    1   2     50.0        0.0       4.1875     0.0        11.0
      0         7.75      23.0        0.0       90.0       0.0        90.0
 133                                            CASING TOP
     -1    1    1   7     60.0        0.0       27.5       0.0        22.
      0         0.0       0.0         6.5       0.0        0.0        0.0
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  233                                                 CASING FRONT
        1     1     1   14      30.0        0.0        27.5       0.0        6.5
        0             22.0       0.0        0.0        0.0       90.0        0.0
  333                                                 CASING BACK
       -1     1     1   14      30.0        0.0        27.5       0.0        6.5
        0              0.0       0.0        0.0        0.0       90.0        0.0
  433                                                 CASING RIGHT SIDE
        1     1     1    6     220.0        0.0        6.5        0.0        22.
        0              0.0      27.5        0.0        0.0        0.0        90.
  533                                                 CASING LEFT SIDE
       -1     1     1    3     110.0        0.0        6.5        0.0        22.
        0              0.0       0.0        0.0        0.0        0.0        90.
  633                                                 CASING BOTTOM
        1     1     1   14     110.0        0.0        27.5       0.0        22.
        0              0.0       0.0        0.0        0.0        0.0        0.0
 -1
END
/ CATV MY/LBAND2/RAVFAC/RAVOUT,ACNM=FT07F001
/ EOSYS FT07F001
/ EOJ
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/ JØB BENNETT,77612634,BENNT2,ØPT=(C,R),CAT=17
/ LIMIT MIN=5,BAND=150
/ PD HIS,USERCAT/077/020/BENNT2
/ FD FT06F001,BAND=5/40/5
/ ASG LRVPLØT2,HIS/LRVPLØT2,USE=SHR
/ EXQT GØ=LRVPLØT2
 L BAND 1 TRANSMITTER RADIATIØN ANALYSIS
   1     0     2     2                                       2     1
  10133                                         RFI PØWER FILTER TØP
         1     1     1    2    30.0       0.0    3.1875     0.0       7.5
         0          0.75        0.75      0.0    0.0        0.0       90.0
  10233                                         RFI PØWER FILTER BØTTØM
        -1     1     1    2    30.0       0.0    3.1875     0.0       7.5
         0          0.75        4.5       0.00   0.0        0.0       90.0
  10333                                         RFI PØWER FILTER FRØNT
        -1     1     1    2    20.0       0.0    3.75       0.0       3.1875
         0          8.25        0.75      0.0    0.0        90.0      0.0
  10433                                         RFI PØWER FILTER BACK
         1     1     1    2    20.0       0.0    3.75       0.0       3.1875
         0          0.75        0.75      0.0    0.0        90.0      0.0
  10533                                         RFI PØWER FILTER RIGHT SIDE
        -1     1     1    2    30.0       0.0    3.75       0.0       7.5
         0          0.75        0.75      3.1875 0.0        0.0       0.0
  10633                                         RFI PØWER FILTER LEFT SIDE
         1     1     1    2    30.0       0.0    3.75       0.0       7.5
         0          0.750       0.75      0.0    0.0        0.0       0.0
  20133                                         CØAX SWITCH 1 TØP
         1     1     1    2    20.0       0.0    2.625      0.0       3.015
         0          0.0         8.5       4.1875 90.0       0.0       0.0
  20233                                         CØAX SWITCH 1 BØTTØM
        -1     1     1    2    20.0       0.0    2.625      0.0       3.015
         0          0.0         8.5       3.0    90.0       0.0       0.0
  20333                                         CØAX SWITCH 1 FRØNT
        -1     1     1    2    10.0       0.0    2.625      0.0       1.1875
         0          0.0         5.485     3.0    90.0       90.0      0.0
  20433                                         CØAX SWITCH 1 BACK
         1     1     1    2    10.0       0.0    2.625      0.0       1.1875
         0          0.0         8.5       3.0     90.0      90.0      0.0
  20533                                         CØAX SWITCH 1 RIGHT SIDE
        -1     1     1    1    20.0       0.0    1.1875      0.0      3.015
         0          2.625       8.5       3.0    90.0        0.0      90.0
  20633                                         CØAX SWITCH 1 LEFT SIDE
         1     1     1    1    20.0       0.0    1.1875     0.0       3.015
         0          0.25        8.5       3.0    90.0       0.0       90.0
  30133                                         CØAX SWITCH 2 TØP
         1     1     1    2    20.0       0.0    3.015      0.0       2.625
         0          2.0         25.485    5.1875 0.0        0.0       0.0
  30233                                         CØAX SWITCH 2 BØTTØM
        -1     1     1    2    20.0       0.0    3.015      0.0       2.625
         0          2.0         25.485    4.0    0.0        0.0       0.0
  30333                                         CØAX SWITCH 2 FRØNT
        -1     1     1    2    10.0       0.0    3.015      0.0       1.1875
         0          4.625       25.485    4.0    0.0        90.0      0.0
  30433                                         CØAX SWITCH 2 BACK
         1     1     1    2    10.0       0.0    3.015      0.0       1.1875
         0          2.0         25.485    4.0    0.0        90.0      0.0
  30533                                         CØAX SWITCH 2 RIGHT SIDE
        -1     1     1    1    20.0       0.0    1.1875     0.0       2.625
         0          2.0         28.25     4.0    0.0        0.0       90.0
  30633                                         CØAX SWITCH 2 LEFT SIDE
         1     1     1    1    20.0       0.0    1.1875     0.0       2.625
         0          2.0         25.485    4.0    0.0        0.0       90.0
  40133                                         CIRCULATØR TØP
         1     1     1    2    20.0       0.0    2.625      0.0       2.875
```

```
       0          9.25      25.875     5.1875     0.0      0.0      0.0
40233                                             CIRCULATOR BOTTOM
      -1    1    1    2    20.0       0.0         2.625    0.0      2.875
       0          9.25      25.875     3.5        0.0      0.0      0.0
40333                                             CIRCULATOR FRONT
      -1    1    1    2    10.0       0.0         2.625    0.0      1.6875
       0          12.125    25.875     3.5        0.0      90.0     0.0
40433                                             CIRCULATOR BACK
       1    1    1    2    10.0       0.0         2.625    0.0      1.6875
       0          9.25      25.875     3.5        0.0      90.0     0.0
40533                                             CIRCULATOR RIGHT SIDE
      -1    1    1    1    20.0       0.0         1.6875   0.0      2.875
       0          9.25      28.25      3.5        0.0      0.0      90.0
40633                                             CIRCULATOR LEFT SIDE
       1    1    1    1    20.0       0.0         1.6875   0.0      2.875
       0          9.25      25.875     3.5        0.0      0.0      90.
50133                                             CAPACITOR 1 TOP
       2    1    7    2    10.0       0.0         1.5      0.1      360.0
       0          16.25     14.5       4.0        0.0      0.0      0.0
50233                                             CAPACITOR 1 BOTTOM
      -2    1    7    2    10.0       0.0         1.5      0.1      360.0
       0          16.25     14.5       0.250      0.0      0.0      0.0
50333                                             CAPACITOR 1 SIDE
       4    1    7    2    31.5       0.0         4.0      0.1      360.0
       0          16.25     14.5       0.0        0.0      0.0      0.0
60133                                             CAPACITOR 2 TOP
       2    1    7    2    10.0       0.0         1.5      0.1      360.0
       0          20.25     14.5       4.0        0.0      0.0      0.0
60233                                             CAPACITOR 2 BOTTOM
      -2    1    7    2    10.0       0.0         1.5      0.1      360.0
       0          20.25     14.5       0.250      0.0      0.0      0.0
60333                                             CAPACITOR 2 SIDE
       4    1    7    2    31.5       0.0         4.0      0.1      360.0
       0          20.25     14.5       0.0        0.0      0.0      0.0
70133                                             POWER SUPPLY 1100 TOP
       1         1    2    30.0       0.0         2.25     0.0      7.0
       0          15.0      9.25       4.1875     0.0      0.0      0.0
70233                                             POWER SUPPLY 1100 BOTTOM
      -1    1    1    2    30.0       0.0         2.25     0.0      6.75
       0          15.0      9.25       0.250      0.0      0.0      0.0
70333                                             POWER SUPPLY 1100 FRONT
      -1    1    1    2    40.0       0.0         2.25     0.0      4.1875
       0          21.75     9.25       0.0        0.0      90.0     0.0
70433                                             POWER SUPPLY 1100 BACK
       1    1    1    2    40.0       0.0         2.25     0.0      4.1875
       0          15.0      9.25       0.0        0.0      90.0     0.0
70533                                             POWER SUPPLY 1100 RIGHT SIDE
      -1    1    1    1    30.0       0.0         4.1875   0.0      7.0
       0          15.0      11.50      0.0        0.0      0.0      90.0
70633                                             POWER SUPPLY 1100 LEFT SIDE
       1    1    1    1    30.0       0.0         4.1875   0.0      7.0
       0          15.0      9.25       0.0        0.0      0.0      90.0
80133                                             FILTER TOP
       1    1    1    1    60.0       0.0         2.5      0.0      12.125
       0          0.0       26.0       2.6875     0.0      0.0      0.0
80233                                             FILTER BOTTOM
      -1    1    1    1    60.0       0.0         2.25     0.0      11.875
       0          0.25      26.0       0.250      0.0      0.0      0.0
80333                                             FILTER FRONT
      -1    1    1    2    20.0       0.0         2.5      0.0      2.6875
       0          12.125    26.0       0.0        0.0      90.0     0.0
80433                                             FILTER BACK
       1    1    1    2    20.0       0.0         2.25     0.0      2.6875
       0          0.250     26.0       0.0        0.0      90.0     0.0
80533                                             FILTER RIGHT SIDE
      -1    1    1    1    60.0       0.0         2.6875   0.0      12.125
```

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        0             0.0          28.25        0.0        0.0         0.0         90.0
80633                                                      FILTER LEFT SIDE
        1      1      1     1      60.0         0.0        2.6875      0.0         12.125
        0             0.0          26.0         0.0        0.0         0.0         90.0
90133                                                      CARD BUCKET BOTTOM DOWN
       -1      1      1     6      30.0         0.0        11.5        0.0         5.5
        0             16.5         17.0         0.48       0.0         0.0         0.0
90233                                                      CARD BUCKET BOTTOM UP
        1      1      1     6      30.0         0.0        11.5        0.0         5.5
        0             16.5         17.0         0.49       0.0         0.0         0.0
90333                                                      CARD BUCKET RIGHT SIDE OUT
       -1      1      1     3      30.0         0.0        6.0         0.0         5.5
        0             16.5         28.45        0.0        0.0         0.0         90.0
90433                                                      CARD BUCKET RIGHT SIDE IN
        1      1      1     3      30.0         0.0        6.0         0.0         5.5
        0             16.5         28.4         0.0        0.0         0.0         90.0
90533                                                      CARD BUCKET LEFT SIDE OUT
        1      1      1     3      30.0         0.0        6.0         0.0         5.5
        0             16.5         17.0         0.0        0.0         0.0         90.0
90633                                                      CARD BUCKET LEFT SIDE IN
       -1      1      1     3      30.0         0.0        6.0         0.0         5.5
        0             16.5         17.05        0.0        0.0         0.0         90.0
91133                                                      CARD 1 LEFT FACE
        1      1      1     3      30.0         0.0        5.5         0.0         5.5
        0             16.5         18.41        0.5        0.0         0.0         90.0
91233                                                      CARD 1 RIGHT FACE
       -1      1      1     3      30.0         0.0        5.5         0.0         5.5
        0             16.5         18.43        0.5        0.0         0.0         90.
92133                                                      CARD 2 LEFT FACE
        1      1      1     3      30.0         0.0        5.5         0.0         5.5
        0             16.5         19.84        0.5        0.0         0.0         90.
92233                                                      CARD 2 RIGHT FACE
       -1      1      1     3      30.0         0.0        5.5         0.0         5.5
        0             16.5         19.86        0.5        0.0         0.0         90.
93133                                                      CARD 3 LEFT FACE
        1      1      1     3      30.0         0.0        5.5         0.0         5.5
        0             16.5         21.27        0.5        0.0         0.0         90.
93233                                                      CARD 3 RIGHT FACE
       -1      1      1     3      30.0         0.0        5.5         0.0         5.5
        0             16.5         21.29        0.5        0.0         0.0         90.
94133                                                      CARD 4 LEFT FACE
        1      1      1     3      30.0         0.0        5.5         0.0         5.5
        0             16.5         22.7         0.5        0.0         0.0         90.0
94233                                                      CARD 4 RIGHT FACE
       -1      1      1     3      30.0         0.0        5.5         0.0         5.5
        0             16.5         22.72        0.5        0.0         0.0         90.
95133                                                      CARD 5 LEFT FACE
        1      1      1     3      30.0         0.0        5.5         0.0         5.5
        0             16.5         24.13        0.5        0.0         0.0         90.
95233                                                      CARD 5 RIGHT FACE
       -1      1      1     3      30.0         0.0        5.5         0.0         5.5
        0             16.5         24.15        0.5        0.0         0.0         90.
96133                                                      CARD 6 LEFT FACE
        1      1      1     3      30.0         0.0        5.5         0.0         5.5
        0             16.5         25.56        0.5        0.0         0.0         90.
96233                                                      CARD 6 RIGHT FACE
       -1      1      1     3      30.0         0.0        5.5         0.0         5.5
        0             16.5         25.58        0.5        0.0         0.0         90.
97133                                                      CARD 7 LEFT FACE
        1      1      1     3      30.0         0.0        5.5         0.0         5.5
        0             16.5         27.0         0.5        0.0         0.0         90.
97233                                                      CARD 7 RIGHT FACE
       -1      1      1     3      30.0         0.0        5.5         0.0         5.5
        0             16.5         27.02        0.5        0.0         0.0         90.
 1133                                                      AMP 1 TOP #1
        1      1      1     2      30.0         0.0        3.25        0.0         5.0
```

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      0          7.25      10.0      1.25      0.0       0.0       0.0
1233                                           AMP 1 BOTTOM #1
     -1    1     1   2     30.0      0.0       3.25      0.0       5.0
      0          7.25      10.0      0.250     0.0       0.0       0.0
1333                                           AMP 1 FRONT #1
     -1    1     1   2     10.0      0.0       3.25      0.0       1.25
      0          12.25     10.0      0.0       0.0       90.0      0.0
1433                                           AMP 1 BACK #1
      1    1     1   2     10.0      0.0       3.25      0.0       1.25
      0          7.25      10.0      0.0       0.0       90.0      0.0
1533                                           AMP 1 LEFT SIDE #1
      1    1     1   1     30.0      0.0       1.25      0.0       5.0
      0          7.25      10.0      0.0       0.0       0.0       90.
2133                                           AMP 1 TOP #2
      1    1     1   2     30.0      0.0       3.25      0.0       5.0
      0          7.25      13.25     1.25      0.0       0.0       0.0
2233                                           AMP 1 BOTTOM #2
     -1    1     1   2     30.0      0.0       3.25      0.0       5.0
      0          7.25      13.25     0.250     0.0       0.0       0.0
2333                                           AMP 1 FRONT #2
     -1    1     1   2     10.0      0.0       3.25      0.0       1.25
      0          12.25     13.25     0.0       0.0       90.0      0.0
2433                                           AMP 1 BACK #2
      1    1     1   2     10.0      0.0       3.25      0.0       1.25
      0          7.25      13.25     0.0       0.0       90.0      0.0
3133                                           AMP 1 TOP #3
      1    1     1   2     30.0      0.0       3.25      0.0       5.0
      0          7.25      16.5      1.25      0.0       0.0       0.0
3233                                           AMP 1 BOTTOM #3
     -1    1     1   2     30.0      0.0       3.25      0.0       5.0
      0          7.25      16.5      0.250     0.0       0.0       0.0
3333                                           AMP 1 FRONT #3
     -1    1     1   2     10.0      0.0       3.25      0.0       1.25
      0          12.25     16.5      0.0       0.0       90.0      0.0
3433                                           AMP 1 BACK #3
      1    1     1   2     10.0      0.0       3.25      0.0       1.25
      0          7.25      16.5      0.0       0.0       90.0      0.0
4133                                           AMP 1 TOP #4
      1    1     1   2     30.0      0.0       3.25      0.0       5.0
      0          7.25      19.75     1.25      0.0       0.0       0.0
4233                                           AMP 1 BOTTOM #4
     -1    1     1   2     30.0      0.0       3.25      0.0       5.0
      0          7.25      19.75     0.250     0.0       0.0       0.0
4333                                           AMP 1 FRONT #4
     -1    1     1   2     10.0      0.0       3.25      0.0       1.25
      0          12.25     19.75     0.0       0.0       90.0      0.0
4433                                           AMP 1 BACK #4
      1    1     1   2     10.0      0.0       3.25      0.0       1.25
      0          7.25      19.75     0.0       0.0       90.0      0.0
4533                                           AMP 1 RIGHT SIDE #4
     -1    1     1   1     30.0      0.0       1.25      0.0       5.0
      0          7.25      23.00     0.0       0.0       0.0       90.0
5133                                           AMP 2 TOP #1
      1    1     1   2     30.0      0.0       3.25      0.0       5.0
      0          0.75      10.0      1.25      0.0       0.0       0.0
5233                                           AMP 2 BOTTOM #1
     -1    1     1   2     30.0      0.0       3.25      0.0       5.0
      0          0.75      10.0      0.250     0.0       0.0       0.0
5333                                           AMP 2 FRONT #1
     -1    1     1   2     10.0      0.0       3.25      0.0       1.25
      0          5.75      10.0      0.0       0.0       90.0      0.0
5433                                           AMP 2 BACK #1
      1    1     1   2     10.0      0.0       3.25      0.0       1.25
      0          0.75      10.0      0.0       0.0       90.0      0.0
5533                                           AMP 2 LEFT SIDE #1
      1    1     1   1     30.0      0.0       1.25      0.0       5.0
```

```
     0            0.75     10.0      0.0       0.0       0.0       90.
6133                                           AMP 2 TOP #2
     1     1      1   2    30.0      0.0       3.25      0.0       5.0
     0            0.75     13.25     1.25      0.0       0.0       0.0
6233                                           AMP 2 BOTTOM #2
    -1     1      1   2    30.0      0.0       3.25      0.0       5.0
     0            0.75     13.25     0.250     0.0       0.0       0.0
6333                                           AMP 2 FRONT #2
    -1     1      1   2    10.0      0.0       3.25      0.0       1.25
     0            5.75     13.25     0.0       0.0       90.0      0.0
6433                                           AMP 2 BACK #2
     1     1      1   2    10.0      0.0       3.25      0.0       1.25
     0            0.75     13.25     0.0       0.0       90.0      0.0
7133                                           AMP 2 TOP #3
     1     1      1   2    30.0      0.0       3.25      0.0       5.0
     0            0.75     16.5      1.25      0.0       0.0       0.0
7233                                           AMP 2 BOTTOM #3
    -1     1      1   2    30.0      0.0       3.25      0.0       5.0
     0            0.75     16.5      0.250     0.0       0.0       0.0
7333                                           AMP 2 FRONT #3
    -1     1      1   2    10.0      0.0       3.25      0.0       1.25
     0            5.75     16.5      0.0       0.0       90.0      0.0
7433                                           AMP 2 BACK #3
     1     1      1   2    10.0      0.0       3.25      0.0       1.25
     0            0.75     16.5      0.0       0.0       90.0      0.0
8133                                           AMP 2 TOP #4
     1     1      1   2    30.0      0.0       3.25      0.0       5.0
     0            0.75     19.75     1.25      0.0       0.0       0.0
8233                                           AMP 2 BOTTOM #4
    -1     1      1   2    30.0      0.0       3.25      0.0       5.0
     0            0.75     19.75     0.250     0.0       0.0       0.0
8333                                           AMP 2 FRONT #4
    -1     1      1   2    10.0      0.0       3.25      0.0       1.25
     0            5.75     19.75     0.0       0.0       90.0      0.0
8433                                           AMP 2 BACK #4
     1     1      1   2    10.0      0.0       3.25      0.0       1.25
     0            0.75     19.75     0.0       0.0       90.0      0.0
8533                                           AMP 2 RIGHT SIDE #4
    -1     1      1   1    30.0      0.0       1.25      0.0       5.0
     0            0.75     23.00     0.0       0.0       0.0       90.0
9133                                           POWER SUPPLY 1400 TOP
     1     1      1   3    50.0      0.0       7.0       0.0       11.0
     0            10.75    0.75      4.1875    0.0       0.0       0.0
9233                                           POWER SUPPLY 1400 BOTTOM
    -1     1      1   3    50.0      0.0       7.0       0.0       11.
     0            10.75    0.75      0.250     0.0       0.0       0.0
9333                                           POWER SUPPLY 1400 FRONT
    -1     1      1   3    20.0      0.0       7.0       0.0       4.1875
     0            21.75    0.75      0.0       0.0       90.0      0.0
9433                                           POWER SUPPLY 1400 BACK
     1     1      1   3    20.0      0.0       7.0       0.0       4.1875
     0            10.75    0.75      0.0       0.0       90.0      0.0
9533                                           POWER SUPPLY 1400 RIGHT SIDE
    -1     1      1   2    50.0      0.0       4.1875    0.0       11.
     0            10.75    7.75      0.0       0.0       0.0       90.
9633                                           POWER SUPPLY 1400 LEFT SIDE
     1     1      1   2    50.0      0.0       4.1875    0.0       11.0
     0            10.75    0.75      0.0       0.0       0.0       90.
 133                                           CASING TOP
    -1     1      1   7    60.0      0.0       28.5      0.0       22.
     0            0.0      0.0       6.5       0.0       0.0       0.0
 233                                           CASING FRONT
     1     1      1  14    30.0      0.0       28.5      0.0       6.5
     0            22.0     0.0       0.0       0.0       90.0      0.0
 333                                           CASING BACK
    -1     1      1  14    30.0      0.0       28.5      0.0       6.5
```

```
          0           0.0         0.0         0.0           0.0        90.0        0.0
     433                                                    CASING RIGHT SIDE
          1     1     1     6   220.0         0.0           6.5         0.0        22.
          0           0.0        28.5         0.0           0.0         0.0        90.
     533                                                    CASING LEFT SIDE
         -1     1     1     3   110.0         0.0           6.5         0.0        22.
          0           0.0         0.0         0.0           0.0         0.0        90.
     633                                                    CASING BOTTOM
          1     1     1    14   110.0         0.0          28.5         0.0        22.
          0           0.0         0.0         0.0           0.0         0.0        0.0
    -1
30.0         -30.0        0.0
L BAND TRANSMITTER

30.0         -30.0        0.0
BENNETT
0.0           0.0         0.0
L BAND TRANSMITTER

0.0           0.0         0.0
BENNETT
0.0          -90.0        0.0
L BAND TRANSMITTER

0.0          -90.0        0.0
BENNETT
END
/ FOSYS FT18F001,TYPE=PLOT
/ EOJ
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Appendix C

COLAPS

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/ JØB BENNETT,77G12634,BENNT2,ØPT=(C,R),CAT=22
/ LIMIT MIN=15,BAND=150
/ FD MY,USERCAT/D77/B20/BENNT2
/ FD FT14F001,BAND=5/20/5
/ FD FT07F001,BAND=5/20/5
/ FD FT06F001,BAND=5/20/5
/ ASG LCØLAPS,MY/CØLAPS/LCØLAPS,USE=SHR
/ FXQT GØ=LCØLAPS,CPTIME=400000,ØPT=(Z,A)
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    2   2
    3   3
    4   4
    5   5   6
    6   7   8
    7   9
    8  10
    9  11
   10  12
   11  13
   12  14
   13  15
   14  16
   15  17
   16  18
   17  19
   18  20
   19  21
   20  22
   21  23
   22  24
   23  25
   24  26
   25  27
   26  28
   27  29
   28  30
   29  31
   30  32
    0
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/ FOSYS FT07F001
/ EOJ
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/ FD FT06F001,BAND=5/20/5
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/ FXQT GO=LSCRPTF
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0.9          0.9          0.9          0.9          0.9          0.9          0.9          0.9
0.5          0.9          0.9          0.9          0.9          0.9          0.9          0.9
0
0
0
0
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/ CATV MY/LBAND2/SCRIPTF,ACNM=FT07F001
/ FØSYS FT07F001
/ EØJ
```

Appendix E

SINDA

```
BCD 3THERMAL LPCS
BCD 9 L-BAND TRANSMITTER
BCD 3 HOT STUDY
END
BCD 3NODE DATA
    1,120.,0.689          $ RF POWER FILTER (BTU/R)
    2,120.,0.325          $ COAXIAL SWITCH 1
    3,120.,0.354          $ COAXIAL SWITCH 2
    4,120.,0.376          $ CIRCULATOR
    5,120.,0.195          $ CAPACITOR 1
    6,120.,0.195          $ CAPACITOR 2
    7,120.,0.466          $ SERIES 1100 POWER SUPPLY
    8,120.,0.410          $ FILTER
    9,120.,0.512          $ CARD BUCKET
    10,120.,0.051         $ CARD 1
    11,120.,0.051         $ CARD 2
    12,120.,0.051         $ CARD 3
    13,120.,0.051         $ CARD 4
    14,120.,0.051         $ CARD 5
    15,120.,0.051         $ CARD 6
    16,120.,0.051         $ CARD 7
    17,120.,0.258         $ AMP 1 #1
    18,120.,0.277         $ AMP 1 #2
    19,120.,0.277         $ AMP 1 #3
    20,120.,0.306         $ AMP 1 #4
    21,120.,0.258         $ AMP 2 #1
    22,120.,0.277         $ AMP 2 #2
    23,120.,0.277         $ AMP 2 #3
    24,120.,0.306         $ AMP 2 #4
    25,120.,1.628         $ 1400 SERIES POWER SUPPLY
    26,120.,7.938         $ CASING TOP
    27,120.,7.938         $ CASING BOTTOM
    28,120.,1.968         $ CASING FRONT
    29,120.,1.968         $ CASING BACK
    30,120.,1.519         $ CASING RIGHT SIDE
    31,120.,1.519         $ CASING LEFT SIDE
    32,120.,0.051         $ AIR INSIDE THE CASING
    33,120.,19.887        $ HEAT SINK PLATE
    -34,112.,1.0          $ TOP BOUNDARY
    -35,112.,1.0          $ BOTTOM BOUNDARY
    -36,112.,1.0          $ FRONT BOUNDARY
    -37,112.,1.0          $ BACK BOUNDARY
    -38,112.,1.0          $ RIGHT SIDE BOUNDARY
    -39,112.,1.0          $ LEFT SIDE BOUNDARY
END
BCD 3CONDUCTOR DATA
    1,1,31,169.245        $ RF FILTER TO LEFT SIDE
    2,1,32,0.200          $              AIR
    -3,1,2,1.714E-11      $              COAXIAL SWITCH 1
    -4,1,25,5.142E-11     $              1400 POWER SUPPLY
    -5,1,26,2.057E-10     $              CASING TOP
    -6,1,27,2.057E-10     $              CASING BOTTOM
    -7,1,29,1.200E-10     $              CASING BACK
    -8,1,31,2.228E-10     $              CASING LEFT SIDE
    9,2,27,51.414         $ COAXIAL SWITCH 1 TO CASING BOTTOM
    10,2,32,0.038         $                     AIR
    -11,2,26,6.856E-11    $                     CASING TOP
    -12,2,27,1.200E-10    $                     CASING BOTTOM
    -13,2,29,6.856E-11    $                     CASING BACK
    -14,2,31,1.714E-11    $                     LEFT SIDE
```

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 6200    15,3,30,4.166            $ COAXIAL SWITCH 2 TO CASING BOTTOM
 6300    16,3,32,0.038            $                         AIR
 6400    -17,3,8,5.142E-11        $                         FILTER
 6500    -18,3,26,8.570E-11       $                         CASING TOP
 6600    -19,3,27,1.714E-11       $                         CASING BOTTOM
 6700    -20,3,29,3.428E-11       $                         CASING BACK
 6800    -21,3,30,6.856E-11       $                         RIGHT SIDE
 6900    22,4,30,3.954            $ CIRCULATOR TO CASING RIGHT SIDE
 7000    23,4,32,0.074            $                  AIR
 7100    -24,4,8,5.142E-11        $                  FILTER
 7200    -25,4,9,1.714E-11        $                  CARD BUCKET
 7300    -26,4,26,1.028E-10       $                  CASING TOP
 7400    -27,4,27,3.428E-11       $                  CASING BOTTOM
 7500    -28,4,29,1.714E-11       $                  CASING BACK
 7600    -29,4,30,1.028E-10       $                  CASING RIGHT SIDE
 7700    30,5,27,5.923            $ CAPACITOR 1 TO CASING BOTTOM
 7800    31,5,32,0.129            $                   AIR
 7900    -32,5,6,5.142E-11        $                   CAPACITOR 2
 8000    -33,5,7,6.856E-11        $                   1100 SERIES POWER
 8100    -34,5,9,6.856E-11        $                   CARD BUCKET
 8200    -35,5,25,1.714E-11       $                   1400 SERIES POWER
 8300    -36,5,26,1.371E-10       $                   CASING TOP
 8400    -37,5,27,1.200E-10       $                   CASING BOTTOM
 8500    -38,5,28,1.714E-11       $                   CASING FRONT
 8600    -39,5,29,1.714E-11       $                   CASING BACK
 8700    -40,5,30,1.714E-11       $                   CASING RIGHT SIDE
 8800    41,6,27,5.923            $ CAPACITOR 2 TO CASING BOTTOM
 8900    42,6,32,0.129            $                   AIR
 9000    -43,6,7,8.570E-11        $                   1100 SERIES POWER
 9100    -44,6,9,1.200E-10        $                   CARD BUCKET
 9200    -45,6,26,6.856E-11       $                   CASING TOP
 9300    -46,6,27,8.570E-11       $                   CASING BOTTOM
 9400    -47,6,28,1.371E-10       $                   CASING FRONT
 9500    48,7,27,70.205           $ 1100 SERIES POWER TO CASING BOTTOM
 9600    49,7,32,0.234            $                         AIR
 9700    -51,7,9,1.714E-11        $                         CARD BUCKET
 9800    -52,7,17,1.714E-11       $                         AMP 1 #1
 9900    -53,7,25,2.228E-10       $                         1400 SEIRES
10000    -54,7,26,2.571E-10       $                         CASING TOP
10100    -55,7,27,2.228E-11       $                         CASING BOTTOM
10200    -56,7,28,2.057E-10       $                         CASING FRONT
10300    -57,7,29,1.714E-11       $                         CASING BACK
10400    58,8,27,478.735          $ FILTER TO CASING BOTTOM
10500    61,8,32,0.180            $              AIR
10600    -62,8,9,1.714E-11        $              CARD BUCKET
10700    -63,8,20,3.428E-11       $              AMP 1 #4
10800    -64,8,24,3.428E-11       $              AMP 2 #4
10900    -65,8,25,1.714E-11       $              1400 SERIES POWER SUPPLY
11000    -66,8,26,2.228E-11       $              CASING TOP
11100    -67,8,27,4.114E-10       $              CASING BOTTOM
11200    -68,8,29,1.371E-10       $              CASING BACK
11300    -69,8,30,3.942E-10       $              CASING RIGHT SIDE
11400    -70,8,31,1.714E-11       $              CASING LEFT SIDE
11500    71,9,27,1.810            $ CARD BUCKET TO BOTTOM
11600    72,9,32,0.257            $                   AIR
11700    -73,9,10,2.400E-10       $                   CARD 1
11800    -74,9,11,5.142E-11       $                   CARD 2
11900    -75,9,12,8.570E-11       $                   CARD 3
12000    -76,9,13,8.570E-11       $                   CARD 4
12100    -77,9,14,5.142E-11       $                   CARD 5
12200    -78,9,15,5.142E-11       $                   CARD 6
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12300    -79,9,16,2.914E-10       $                    CARD 7
12400    -80,9,25,1.714E-11       $                    1400 SERIES POWER
12500    -81,9,26,2.914E-10       $                    CASING TOP
12600    -82,9,27,6.856E-10       $                    CASING BOTTOM
12700    -83,9,28,2.057E-10       $                    CASING FRONT
12800    -84,9,29,1.714E-11       $                    CASING BACK
12900    -85,9,30,3.428E-10       $                    CASING RIGHT SIDE
13000    -86,9,31,1.714E-11       $                    CASING LEFT SIDE
13100    87,10,9,2.183            $ CARD 1 TO CARD BUCKET
13200    88,10,32,0.229           $           AIR
13300    -89,10,11,2.057E-10      $           CARD 2
13400    -90,10,26,1.714E-11      $           CASING TOP
13500    -91,10,27,1.714E-11      $           CASING BOTTOM
13600    -92,10,28,1.028E-10      $           CASING FRONT
13700    93,11,9,2.183            $ CARD 2 TO CARD BUCKET
13800    94,11,32,0.229           $           AIR
13900    -95,11,12,2.228E-10      $           CARD 3
14000    -96,11,26,5.142E-11      $           CASING TOP
14100    -97,11,27,1.714E-11      $           CASING BOTTOM
14200    -98,11,28,3.428E-11      $           CASING FRONT
14300    99,12,9,2.183            $ CARD 3 TO CARD BUCKET
14400    100,12,32,0.229          $           AIR
14500    -101,12,13,1.865E-10     $           CARD 4
14600    -102,12,26,5.142E-11     $           CASING TOP
14700    -103,12,27,1.714E-11     $           CASING BOTTOM
14800    -105,12,28,1.714E-11     $           CASING FRONT
14900    107,13,9,2.183           $ CARD 4 TO CARD BUCKET
15000    108,13,32,0.229          $           AIR
15100    -109,13,14,1.885E-10     $           CARD 5
15200    -110,13,26,1.714E-11     $           CASING TOP
15300    -111,13,27,1.714E-11     $           CASING BOTTOM
15400    -112,13,28,1.028E-10     $           CASING FRONT
15500    113,14,9,2.183           $ CARD 5 TO CARD BUCKET
15600    114,14,32,0.229          $           AIR
15700    -115,14,15,1.865E-10     $           CARD 6
15800    -116,14,26,3.428E-11     $           CASING TOP
15900    -117,14,27,1.714E-11     $           CASING BOTTOM
16000    -118,14,28,6.856E-11     $           CASING FRONT
16100    119,15,9,2.183           $ CARD 6 TO CARD BUCKET
16200    120,15,32,0.229          $           AIR
16300    -121,15,16,2.057E-10     $           CARD 7
16400    -122,15,26,3.428E-11     $           CASING TOP
16500    -123,15,27,1.714E-11     $           CASING BOTTOM
16600    -124,15,28,1.714E-11     $           CASING FRONT
16700    -125,15,30,1.714E-11     $           CASING RIGHT SIDE
16800    126,16,9,2.183           $ CARD 7 TO CARD BUCKET
16900    127,16,32,0.229          $           AIR
17000    -128,16,26,3.428E-11     $           CASING TOP
17100    -129,16,27,1.714E-11     $           CASING BOTTOM
17200    -130,16,28,1.714E-11     $           CASING FRONT
17300    -131,16,30,1.714E-11     $           CASING RIGHT SIDE
17400    132,17,18,21.260         $ AMP 1 #1 TO AMP 1 #2
17500    133,17,27,0.864          $              CASING BOTTOM
17600    134,17,32,0.081          $              AIR
17700    -135,17,21,1.714E-11     $              AMP 2 #2
17800    -136,17,25,3.428E-11     $              1400 SERIES POWER SUP.
17900    -137,17,26,1.543E-11     $              CASING TOP
18000    -138,17,27,2.228E-10     $              CASING BOTTOM
18100    -139,17,29,1.714E-11     $              CASING BACK
18200    -140,17,31,1.714E-11     $              CASING LEFT SIDE
18300    141,18,19,21.260         $ AMP 1 #2 TO AMP 1 #3
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18400        142,18,27,3.456            $                 CASING BOTTOM
18500        143,18,32,0.089            $                 AIR
18600        -144,18,22,1.714E-11       $                 AMP 2 #2
18700        -145,18,26,1.543E-10       $                 CASING TOP
18800        -146,18,27,1.885E-10       $                 CASING BOTTOM
18900        -147,18,29,1.714E-11       $                 CASING BACK
19000        148,19,20,21.260           $ AMP 1 #3 TO AMP 1 #4
19100        149,19,27,3.456            $                 CASING BOTTOM
19200        150,19,32,0.089            $                 AIR
19300        -151,19,23,1.714E-11       $                 AMP 2 #3
19400        -152,19,26,1.543E-10       $                 CASING TOP
19500        -153,19,27,1.885E-11       $                 CASING BOTTOM
19600        -154,19,29,1.714E-11       $                 CASING BACK
19700        155,20,27,3.456            $ AMP 1 #4 TO CASING BOTTOM
19800        156,20,32,0.094            $                 AIR
19900        -157,20,24,1.714E-11       $                 AMP 2 #4
20000        -158,20,26,1.543E-10       $                 CASING TOP
20100        -159,20,27,2.057E-10       $                 CASING BOTTOM
20200        -160,20,29,1.714E-11       $                 CASING BACK
20300        -161,20,30,1.714E-11       $                 CASING RIGHT SIDE
20400        162,21,22,21.260           $ AMP 2 #1 TO AMP 2 #2
20500        163,21,27,0.864            $                 CASING BOTTOM
20600        164,21,32,0.081            $                 AIR
20700        -165,21,25,1.714E-11       $                 1400 SERIES POWER SUP.
20800        -166,21,26,1.371E-10       $                 CASING TOP
20900        -167,21,27,2.057E-10       $                 CASING BOTTOM
21000        -168,21,29,8.570E-11       $                 CASING BACK
21100        -169,21,31,1.714E-11       $                 CASING LEFT SIDE
21200        170,22,23,21.260           $ AMP 2 #2 TO AMP 2 #3
21300        171,22,27,3.456            $                 CASING BOTTOM
21400        172,22,32,0.089            $                 AIR
21500        -173,22,26,1.371E-10       $                 CASING TOP
21600        -174,22,27,1.714E-10       $                 CASING BOTTOM
21700        -175,22,29,6.856E-11       $                 CASING BACK
21800        176,23,24,21.260           $ AMP 2 #3 TO AMP 2 #4
21900        177,23,27,3.456            $                 CASING BOTTOM
22000        178,23,32,0.089            $                 AIR
22100        -179,23,26,1.371E-10       $                 CASING TOP
22200        -180,23,27,1.714E-10       $                 CASING BOTTOM
22300        -181,23,29,6.856E-11       $                 CASING BACK
22400        182,24,27,3.456            $ AMP 2 #4 TO CASING BOTTOM
22500        183,24,32,0.094            $                 AIR
22600        -184,24,26,1.371E-10       $                 CASING TOP
22700        -185,24,27,1.885E-10       $                 CASING BOTTOM
22800        -186,24,29,8.570E-11       $                 CASING BACK
22900        -187,24,30,1.714E-11       $                 CASING RIGHT SIDE
23000        188,25,27,386.130          $ 1400 SERIES POWER TO CASING BOTTOM
23100        189,25,32,0.697            $                        AIR
23200        -190,25,26,8.056E-10       $                        CASING TOP
23300        -191,25,27,9.770E-10       $                        CASING BOTTOM
23400        -192,25,28,3.771E-10       $                        CASING FRONT
23500        -193,25,29,6.856E-11       $                        CASING BACK
23600        -194,25,30,1.714E-11       $                        RIGHT SIDE
23700        -195,25,31,5.485E-10       $                        LEFT SIDE
23800        196,26,28,4.435            $ CASING TOP TO CASING FRONT
23900        197,26,29,4.435            $               CASING BACK
24000        198,26,30,3.423            $               CASING RIGHT SIDE
24100        199,26,31,3.423            $               CASING LEFT SIDE
24200        200,26,32,2.003            $               AIR
24300        -201,26,27,1.371E-09       $               CASING BOTTOM
24400        -202,26,28,3.942E-10       $               CASING FRONT
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                    -203,26,29,6.170E-10     $                CASING BACK
                    -204,26,30,2.228E-10     $                CASING RIGHT SIDE
                    -205,26,31,3.085E-10     $                CASING LEFT SIDE
                    206,27,28,4.435          $ CASING BOTTOM  TO CASING FRONT
                    207,27,29,4.435          $                    CASING BACK
                    208,27,30,3.423          $                    CASING RIGHT SIDE
                    209,27,31,3.423          $                    CASING LEFT SIDE
                    210,27,32,1.001          $                    AIR
                    211,27,33,1000.          $                    HEAT SINK PLATE
                    -212,27,28,8.570E-11     $                    CASING FRONT
                    -213,27,29,2.571E-10     $                    CASING BACK
                    -214,27,30,1.200E-10     $                    RIGHT SIDE
                    -215,27,31,1.543E-10     $                    LEFT SIDE
                    216,28,30,2.033          $ CASING FRONT TO RIGHT SIDE
                    217,28,31,2.033          $                  LEFT SIDE
                    218,28,32,0.395          $                  AIR
                    -219,28,29,5.142E-11     $                  CASING BACK
                    -220,28,30,1.714E-11     $                  RIGHT SIDE
                    -221,28,31,8.570E-11     $                  LEFT SIDE
                    222,29,30,2.033          $ CASING BACK TO RIGHT SIDE
                    223,29,31,2.033          $                 LEFT SIDE
                    224,29,32,0.434          $                 AIR
                    -225,29,30,6.856E-11     $                 RIGHT SIDE
                    -226,29,31,6.856E-11     $                 LEFT SIDE
                    227,30,32,0.149          $ CASING RIGHT SIDE TO AIR
                    -228,30,31,1.714E-11     $                        LEFT SIDE
                    229,31,32,0.263          $ CASING LEFT SIDE TO AIR
                    230,26,34,3.843          $ CASING TOP TO BOUNDARY
                    231,33,35,100.00         $ HEAT SINK TO BOUNDARY
                    232,28,36,0.953          $ CASING FRONT TO BOUNDARY
                    233,29,37,0.953          $ CASING BACK TO BOUNDARY
                    234,30,38,0.903          $ CASING RIGHT SIDE TO BOUNDARY
                    235,31,39,0.368          $ CASING LEFT SIDE TO BOUNDARY
                    236,33,34,0.971          $ HEAT SINK TO TOP BOUNDARY
               END
               BCD 3CONSTANTS DATA
                    TIMEO,0.0
                    DTIMEI,0.0083333
                    DRLXCA,0.25
                    ARLXCA,0.25
                    TIMEND,0.999996          $ 30 MINUTE CYCLE TIME
                    OUTPUT,0.083333          $ OUTPUT EVERY 5 MINUTES
                    NLOOP,500                $ MAXIMUM ITERATIONS
                    1,68.24                  $ RF POWER FILTER (BTU/HR)
                    2,0.0                    $ COAXIAL SWITCH 1
                    3,0.0                    $ COAXIAL SWITCH 2
                    4,18.29                  $ CIRCULATOR (BTU/HR)
                    5,0.0                    $ CAPACITOR 1
                    6,0.0                    $ CAPACITOR 2
                    7,61.42                  $ 1100 SERIES POWER SUPPLY
                    8,20.47                  $ FILTER
                    9,0.0                    $ CARD BUCKET
                    10,0.0                   $ CARD 1
                    11,85.30                 $ CARD 2
                    12,85.30                 $ CARD 3
                    13,85.30                 $ CARD 4
                    14,85.30                 $ CARD 5
                    15,0.0                   $ CARD 6
                    16,17.06                 $ CARD 7
                    17,17.06                 $ AMP 1 #1
                    18,34.12                 $ AMP 1 #2
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                 19,170.60                    $ AMP 1 #3
                 20,272.97                    $ AMP 1 #4
                 21,17.06                     $ AMP 2 #1
                 22,34.12                     $ AMP 2 #2
                 23,170.60                    $ AMP 2 #3
                 24,272.97                    $ AMP 2 #4
                 25,759.53                    $ 1400 SERIES POWER SUPPLY (BTU/HR)
                 26,0.0                       $ USED TO ZERO OUT HEAT SOURCES
            END
            BCD 3ARRAY DATA
                 1                                                   $ TIME ARRAY
                 0.000,0.008,0.017,0.025,0.033,0.042,0.050,0.058,0.067,0.075
                 0.083,0.092,0.100,0.108,0.117,0.125,0.133,0.142,0.150,0.158
                 0.167,0.175,0.183,0.192,0.200,0.208,0.217,0.225,0.233,0.242
                 0.250,0.258,0.267,0.275,0.283,0.292,0.300,0.308,0.317,0.325
                 0.333,0.342,0.350,0.358,0.367,0.375,0.383,0.392,0.400,0.408
                 END    $ TIME IN HOURS BY 1/2 MINUTE INCREMENTS
            END
            BCD 3EXECUTION
F          DIMENSION X(2000)
F          NDIM=2000
F          NTH=0
F          DO 10 ICOU=1,5
                 FWDBCK
M          TIMEO=0.0
F10        CONTINUE
            END
            BCD 3VARIABLES 1
M          IF(TIMEM.GT.0.084.AND.TIMEM.LE.0.5)GO TO 10
M          IF(TIMEM.GT.0.583333)GO TO 10
                 SHFTV(25,K1,Q1)              ! SHIFT HEAT SOURCE INTO COMPONENTS
F          GO TO 20
F10        CONTINUE
                 ARYMPY(25,Q1,K26,Q1)         ! ZERO OUT HEAT SOURCES
                 SHFTV(1,K16,Q16)             ! A/D LOGIC CARD ALWAYS ON
F20        CONTINUE
            END
            BCD 3VARIABLES 2
            END
            BCD 3OUTPUT CALLS
                 TPRINT
            END
            BCD 3END OF DATA
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