Contract NAS9-13033
DRL No. T-815
DRL Line Item 7
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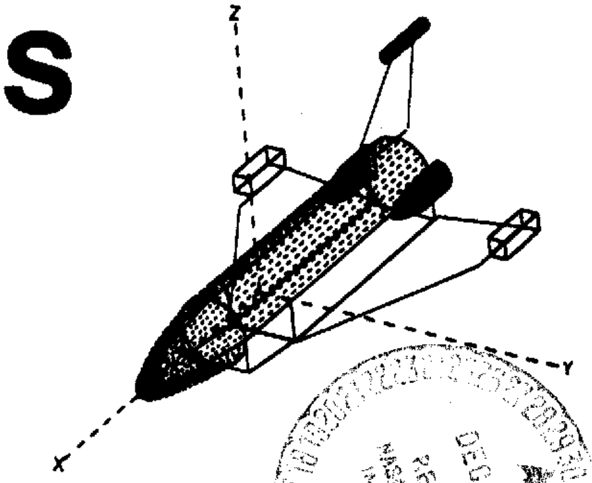
Programmer's Manual

May 1974

Thermal Radiation Analysis System

TRASYS



MARTIN MARIETTA

MCR-74-107
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Programmer's
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THERMAL RADIATION ANALYSIS SYSTEM

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FOREWORD

The Martin Marietta Thermal Radiation Analyzer System (TRASYS) program marks the first instance that thermal radiation analysis has been put on the same basis as thermal analysis using program systems such as MITAS and SINDA. As with these thermal analyzer programs, the user is provided the powerful options of writing his own executive or driver logic and choosing, among several available options, the most desirable solution techniques for the problem at hand. In addition, TRASYS provides many features never before available in a single radiation analysis program. Among the more important are:

- A 1000-node problem size capability with shadowing by intervening opaque or semitransparent surfaces;
- A choice of diffuse, specular, or diffuse/specular radiant interchange solutions;
- A capability for time-variant geometry in orbit;
- A choice of analytically determined or externally supplied shadow data for environmental flux calculations;
- Form factors and environmental fluxes computed using an internally-optimized number of surface grid elements, selected on the basis of user-supplied accuracy criteria;
- A general editing capability for updating thermal radiation model data stored on tape;
- A plot package that provides a pictorial representation of the user's geometry.

TRASYS is indebted to a number of predecessor programs in the thermal radiation analysis field. The major contributors were HEATRATE, MTRAP version 2.0, RADFAC, and the MRI computer program for determining external radiation absorbed by the Apollo spacecraft.

This programmers' manual represents an effort to provide scientific programming personnel with the descriptive material necessary to reach an understanding of the various program segments. Due to the highly modularized design of TRASYS, there are 166 preprocessor subroutines and over 300 processor library subroutines described herein. Although this is a rather large number in total, the individual subroutines have a more moderate size, so that the user can develop a working understanding of any routine after devoting a reasonable amount of effort to reading the Fortran code and consulting the appropriate material herein.

This manual was generated for the National Aeronautics and Space Administration's Lyndon B. Johnson Spacecraft Center under NASA Contract NAS9-13033, *Development of a Thermal Radiation Analysis/ Heat Rate Computer Program System.* The technical monitoring for this program was provided by Mr. Robert A. Vogt of the Thermal Technology Branch of the Structures and Mechanics Division, NASA Lyndon B. Johnson Space Center. His helpful suggestions during the development of TRASYS are gratefully acknowledged.

TRASYS would not exist without the superb design and programming efforts of Messrs. Ronald E. Paulson and Robert J. Connor, who were responsible for generating the majority of the TRASYS code. Their efforts are gratefully acknowledged. Extensive thanks are also due Mr. G. M. Holmstead for his efforts in developing the direct irradiation program segment and for the valuable consulting effort he performed during the course of program development. Mr. Richard G. Goble is also recognized for his praiseworthy efforts in developing the specular-diffuse radiation interchange segment, the orbit plotter segment, and for his solutions of many knotty problems that cropped up during program checkout.

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INTRODUCTION

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A. WHAT IS TRASYS?

TRASYS, the Martin Marietta Thermal Radiation Analysis System, is a digital computer software system with a generalized capability to solve the radiation-related aspects of thermal analysis problems. When used in conjunction with a generalized thermal analysis program such as the Systems Improved Numerical Differencing Analyzer (SINDA) program, any thermal problem that can be expressed in terms of a lumped-parameter, radiation-conductor thermal network can be solved.

The function of TRASYS is twofold. It provides:

1) Internode radiation interchange data;

2) Incident and absorbed heat rate data from environmental radiant heat sources.

Data of both types are provided in a format directly usable by the thermal analyzer programs.

A primary feature of TRASYS is that it allows the user to write his own executive or driver program, which organizes and directs the program library routines to solve each specific problem in the most expeditious manner. The user also may write his own output routines; thus, the data output can directly interface with any thermal analyzer using the R-C network concept.

Other outstanding features of TRASYS include:

1) A 1000-node allowable problem size;

2) The ability to accommodate time-variable problem geometry;

3) An editing capability that allows the combination or separation of multiple thermal radiation models;

4) A plot package that provides pictorial plots of input geometry and orbit data, as well as output data.

The TRASYS system consists of two major components: the preprocessor, and the processor library. The preprocessor has two major functions. First, it reads and converts the user's geometry input data into the form used by the processor library routines. Second, it accepts the user's driving logic (written in the TRASYS-modified FORTRAN language) that directs user-provided and/or library consists of FORTRAN language routines that perform the functions commonly needed by the user. The user has, in some cases, a choice of solution techniques for performing the same function.

SYSTEM STRUCTURE

In the usual engineering environment, a programmer is commissioned to prepare an applications program that is subsequently made available to the engineer on a production basis. The engineer supplies input data and receives output data, as shown in Figure I-1.

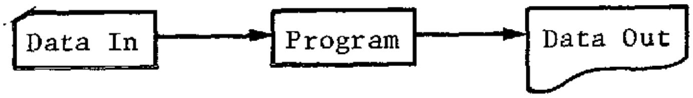

Figure I-1
Basic Flow in Using an Applications Program

In most cases, changes to the logic and equations are difficult for the program user to implement conveniently since they must be written in a computer-oriented language and may be submitted through a formal programming organization. When TRASYS is used, however, the engineer need only call on the programmer to supply a standard deck of computer-oriented "control cards" that will call the various elements of the system into action in the proper sequence. The engineer then formulates his problem in the engineering-oriented TRASYS language, assembling both data and solution techniques (i.e., logic and equations) into this card deck, which then serves as the complete input to the TRASYS system. Programmer support has been minimized since the bulk of the programming effort is already built into the TRASYS preprocessor and processor library. The engineering user need only specify the data and the order and type of "program building blocks" he deems necessary to solve his problem (see Fig. I-2).

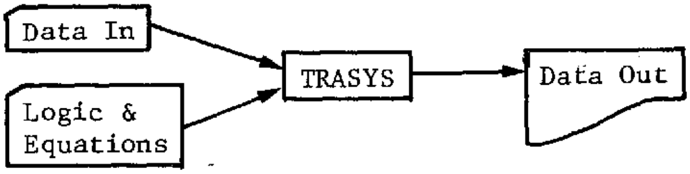

Figure I-2 Basic Flow in Using TRASYS

It should be evident that TRASYS is much more than an applications program. It has, in fact, all the functions and capabilities of a special-purpose operating system. Since most computers currently used in engineering environments already have operating systems built around a FORTRAN compiler, TRASYS is designed to augment the existing FORTRAN system. Hence, the TRASYS library serves as an extension to the existing FORTRAN library, and the TRASYS program serves as a preprocessor to (i.e., it preceeds) the existing FORTRAN compiler. This augmentation arrangement is illustrated in Figure I-3.

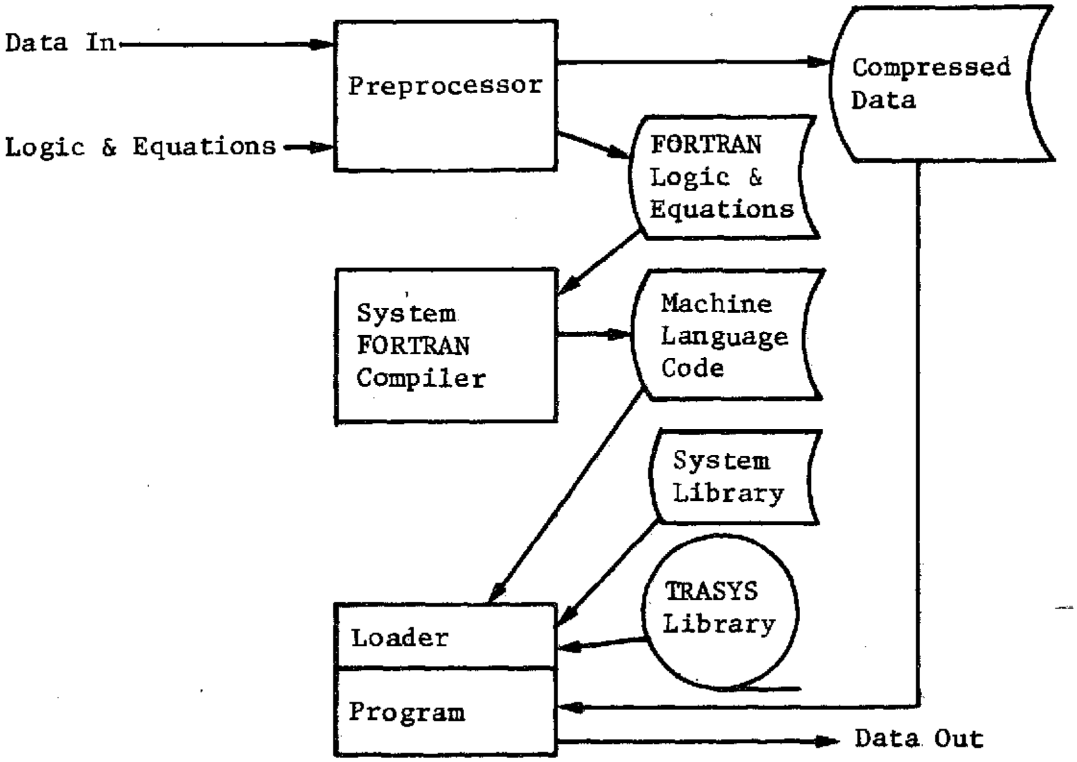

Figure I-3 Internal Flow of TRASYS

When using the full capability of TRASYS, the user will be required to exert a programming effort of sorts, in a language consisting of FORTRAN statements and problem-oriented TRASYS statements that are FORTRAN-related. This, together with the wide variety of options and features offered by the system, suggests an appropriate word of caution: TRASYS is a comprehensive system that cannot be mastered overnight. Nevertheless, to help the novice user, we have attempted to default much of the required input to normally used values so that the user need not define them.

II. PART 1 - PREPROCESSOR

A. SEGMENT DEFINITIONS

SEGMENT DEFINITIONS - PREPROCESSOR

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A. SEGMENT DEFINITIONS

SEGMENT NAME: TRASYS

PURPOSE: Driver segment of the TRASYS preprocessor (see Fig. II-1).

CALLING SEGMENT: None

SEGMENTS CALLED:	START	LOGICO	RAPUP
	DATARD	TPGEN	

SEGMENT NAME: START

PURPOSE: This segment is the main driver segment for the preprocessor initalization, model collector, source editor, and edit output tape generator segments.

CALLING SEGMENT: TRASYS

SEGMENTS CALLED:	INITAL	SEDIT
	MCOL	GNEDO

SEGMENT NAME: INITAL

PURPOSE: This segment initializes the preprocessor-labeled common, writes the TRASYS banner on the output file, and reads in and processes the OPTION DATA block.

CALLING SEGMENT: START

SEGMENTS CALLED: None

SEGMENT NAME: MCOL

PURPOSE: This segment combines models that reside on separate edit output tapes. The output of segment MCOL is the EMERG file.

CALLING SEGMENT: START

SEGMENTS CALLED: None

Figure II-1

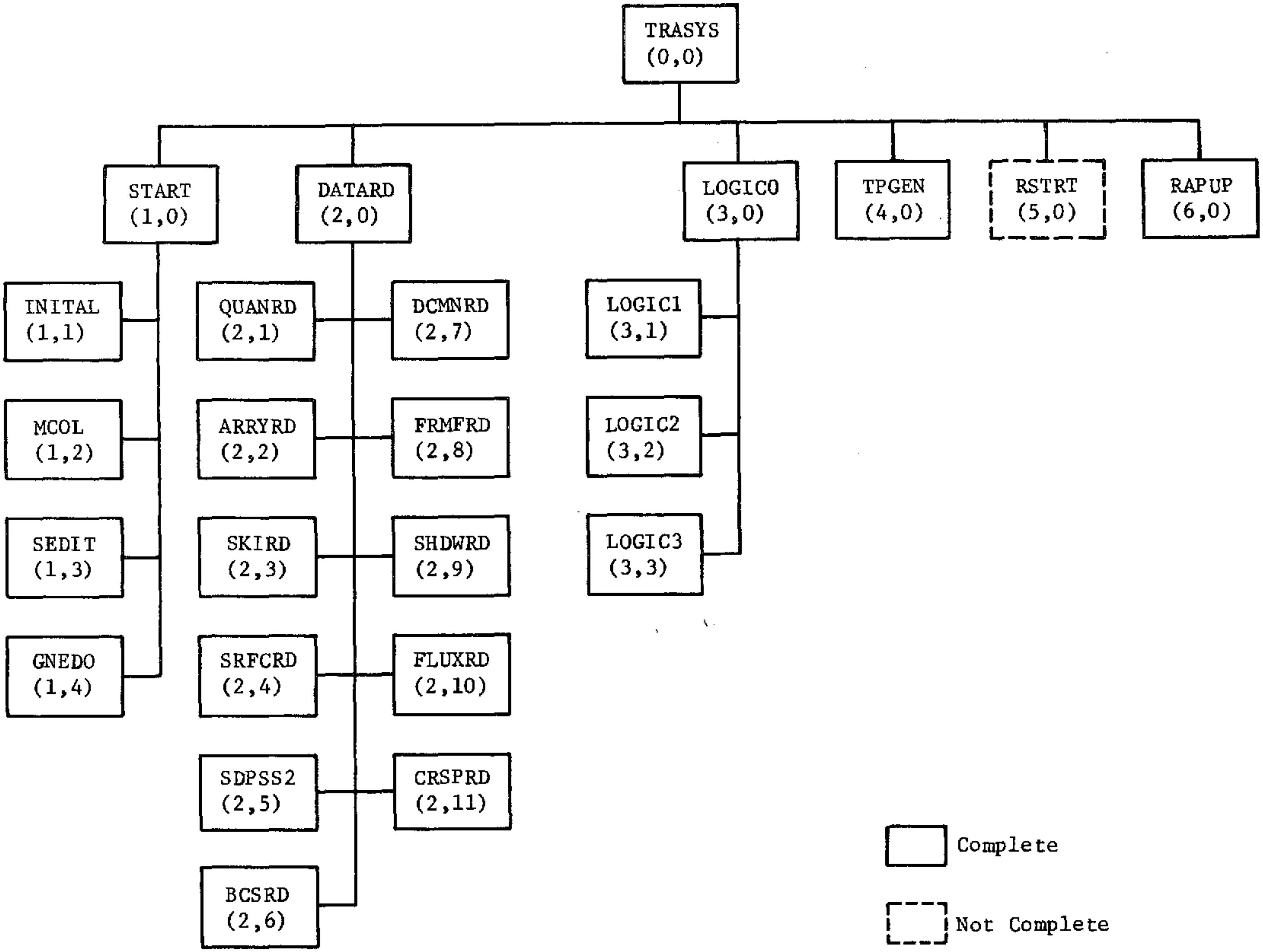

Figure II-1 Diagram of Preprocessor Segment Structure

SEGMENT NAME: SEDIT

PURPOSE: This segment performs the source edit function of the preprocessor. Input data are read from the INPUT, CMERG, EMERG, and EDITI files and output is written to the DATAI file.

CALLING SEGMENT: START

SEGMENTS CALLED: None

SEGMENT NAME: GNEDO

PURPOSE: This segment generates the EDITO file from the DATAI and EDITI files.

CALLING SEGMENT: START

SEGMENTS CALLED: None

SEGMENT NAME: DATARD

PURPOSE: This segment is the main driver segment that reads in and processes the user's data input block.

CALLING SEGMENT: TRASYS

SEGMENTS CALLED: QUANRD
ARRYRD
SKIRD
SRFCRD
SDPSS2
BCSRD
DCMNRD
FRMFRD
SHDWRD
FLUXRD
CRSPRD

SEGMENT NAME: QUANRD

PURPOSE: This segment reads in and processes the user's QUANTITIES DATA input block.

CALLING SEGMENT: DATARD

SEGMENTS CALLED: None

SEGMENT NAME: ARRYRD

PURPOSE: This segment reads in and processes the user's ARRAY DATA input block.

CALLING SEGMENT: DATARD

SEGMENTS CALLED: None

SEGMENT NAME: SKIRD

PURPOSE: This segment reads in and processes the user-input "I" and "K" cards of the user's SURFACE DATA input block.

CALLING SEGMENT: DATARD

SEGMENTS CALLED: None

SEGMENT NAME: SRFCRD

PURPOSE: This segment reads in the "S", "R", "D", "N", and "B" cards of the user's SURFACE DATA input block. These data are combined with the output of segment SKIRD and are output on file MRIOS for final processing in segment SDPSS2.

CALLING SEGMENT: DATARD

SEGMENTS CALLED: None

SEGMENT NAME: SDPSS2

PURPOSE: This segment completes the processing of the user's SURFACE DATA input block.

CALLING SEGMENT: DATARD

SEGMENTS CALLED: None

SEGMENT NAME: BCSRD

PURPOSE: This segment reads in and processes the user's BCS DATA input block. This segment also reads the NODE/BCS directory generated by segment SDPSS2 and processes it with the user's input data to form the communication link between the BCS data and the SURFACE data.

CALLING SEGMENT: DATARD

SEGMENTS CALLED: None

SEGMENT NAME: DCMNRD

PURPOSE: This segment reads in and writes out to the system output file the user's DOCUMENTATION DATA input block.

CALLING SEGMENT: DATARD

SEGMENTS CALLED: None

SEGMENT NAME: FRMFRD

PURPOSE: This segment reads in and processes the user's FORM FACTOR DATA input block.

CALLING SEGMENT: DATARD

SEGMENTS CALLED: None

SEGMENT NAME: SHDWRD

PURPOSE: This segment reads in and processes the user's SHADOW FACTOR DATA input block.

CALLING SEGMENT: DATARD

SEGMENTS CALLED: None

SEGMENT NAME: FLUXRD

PURPOSE: This segment reads in and processes the user's FLUX DATA input block.

CALLING SEGMENT: DATARD

SEGMENTS CALLED: None

SEGMENT NAME: CRSPRD

PURPOSE: This segment reads in and processes the user's CORRESPONDENCE DATA input block.

CALLING SEGMENT: DATARD

SEGMENTS CALLED: None

SEGMENT NAME: LOGICO

PURPOSE: This segment is the driver segment for the segments that read in and process the user's OPERATIONS DATA block.

CALLING SEGMENT: TRASYS

SEGMENTS CALLED: LOGIC1
LOGIC2
LOGIC3

SEGMENT NAME: LOGIC1

PURPOSE: This routine reads in the user's OPERATIONS DATA block and sets up all the variables needed to write the ODPROG segment of the processor.

CALLING SEGMENT: LOGICO

SEGMENTS CALLED: None

SEGMENT NAME: LOGIC2

PURPOSE: This routine reads the output of segment LOGIC1 and writes to the processor compile file CMPL, the main processor segment, TRASYS, and the ODPROG subsegment.

CALLING SEGMENT: LOGICO

SEGMENTS CALLED: None

SEGMENT NAME: LOGIC3

PURPOSE: This segment reads in and processes the user's SUBROUTINE DATA block and writes to the processor compiler file CMPL all subsegments of the processor that require compilation.

CALLING SEGMENT: LOGICO

SEGMENTS CALLED: None

SEGMENT NAME: TPGEN

PURPOSE: This routine writes the needed driver information of the processor to the sequential data file SQNTL.

CALLING SEGMENT: TRASYS

SEGMENTS CALLED: None

SEGMENT NAME: RAPUP

PURPOSE: This segment wraps up the preprocessor execution phase.

CALLING SEGMENT: TRASYS

SEGMENTS CALLED: None

B. SUBROUTINE AND FUNCTION DESCRIPTIONS - PREPROCESSOR

SUBROUTINE AND FUNCTION DESCRIPTIONS
- PREPROCESSOR

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ROUTINE NAME: AAAAAA

DESCRIPTION: This routine initializes the variables containing the last program modifications number and date.

CALLING SEQUENCE: CALL AAAAAA (V, D)

V - Last version modification number
D - Date of last modification

REFERENCED BY:

SEGMENT	ROUTINE
INITAL	INITAL

ROUTINE NAME: ABNORM1 (CDC system routine)

DESCRIPTION: This routine when called causes the program to terminate abnormally with error traceback.

CALLING SEQUENCE: CALL ABNORM1 (P1, P2, P3)

P1 - The name of the calling subroutine; left-justified, Hollerith input

P2 - A decimal number, maximum of 88, which is used as an error number. Must not be 0

P3 - The error message; left-justified zero-filled. The message must be terminated with 4 octal zeros in the rightmost position of a word

REFERENCED BY:

SEGMENT	ROUTINE
TRASYS	ABT1
INITAL	OPTNRD

PRECEDING PAGE BLANK NOT FILMED

ROUTINE NAME: ABT1

DESCRIPTION: This is an abnormal exit routine for the TRASYS preprocessor.

CALLING SEQUENCE: CALL ABT1 (N, NO)

N - Name of the routine exiting from. The name is left-justified and the rest of the field blanked within the word

NO - Type of error
= 1 User input error
= 2 Bad source edit input tape
= 3 TAPE/DISK/DRUM read error
= 4 Program limitations exceeds
= 5 Job field length too short
= 6 Programmer error

REFERENCED BY:

SEGMENT	ROUTINE	SEGMENT	ROUTINE	SEGMENT	ROUTINE
TRASYS	HCARD	SRFCRD	SRFCS1	FLUXRD	FLUXRD
	INRCD		CDPRC3	CRSPRD	CRSPRD
	SERROR		DUPSRF	LOGICD	WCMMN
INITAL	UNITCG		REFCD	LOGIC1	LOGIC1
SEDIT	SEDIT	SDPSS2	SDPSS2		LP1
	INRDPP	BCSRD	BCSRD		ORBGEN
GNEDO	GNEDO		BCSP1		ORBIN
QUANRD	QUANRD		BCSP2		ORBNPL
	QUANSD	FRMFRD	FINAL		ORBPL
ARRYRD	ARRYRD	SHDWRD	SHDWRD		ORBPLC
SKIRD	IP1		SFRSI	RAPUP	RAPUP
	IP2				
	KP2				

ROUTINE NAME: ARRYRD

DESCRIPTION: This routine reads in and processes the user array input block.

CALLING SEQUENCE: CALL ARRYRD

REFERENCED BY:	SEGMENT	ROUTINE
	DATARD	DATARD

FILES: NRIO - Writes three records to the random I/O file
Record 1 - Array names/input card sequence number
Record 2 - Array starting positions with respect to the output array common/length of the array +1
Record 3 - Array data
NSC1 - Temporary file to store the array data
NSC2 - Temporary file to store the array lengths
NOUT - System output file

ROUTINE NAME: ASKCRD

DESCRIPTION: This routine decodes the user input source edit control cards for the preprocessor source editor.

CALLING SEQUENCE: CALL ASKCRD (IER)

IER - Error detection flag
= 0 No error found
= 1 One or more errors found

KEY VARIABLES: Card data passed to this routine is common/CARD/ variables NCDTYP and IND. Decoded information is returned in common/card/variable IND, NDOT, IDOT, JDOT.

REFERENCED BY:	SEGMENT	ROUTINE
	SEDIT	SEDIT

FILES: NOUT - System output file

ROUTINE NAME: AUTOCM

DESCRIPTION: This routine sets up a correspondence data file on NGBIRR for the automatic combination of surfaces generated by a user-input polygon.

CALLING SEQUENCE: CALL AUTOCM

REFERENCED BY:

SEGMENT	ROUTINE
SDPSS2	POLYGN

FILES: NGBIRR

ROUTINE NAME: BANNPP

DESCRIPTION: This routine prints the banner page for the TRASYS preprocessor on the output file.

CALLING SEQUENCE: CALL BANNPP

REFERENCED BY:

SEGMENT	ROUTINE
INITAL	INITAL

FILES: NOUT - System output file

ROUTINE NAME: BCSP1

DESCRIPTION: This routine processes the first pass on the user-input BCS input data block.

CALLING SEQUENCE: CALL BCSP1 (NIX)

NIX - Last cell used in dynamic storage, blank common variable (IX)

KEY VARIABLE: IX - Data once converted from user input are passed to the BCSP2 routine via this blank common variable

REFERENCED BY:

SEGMENT	ROUTINE
BCSRD	BCSRD

FILES: NOUT - System output file

ROUTINE NAME: BCSP2

DESCRIPTION: This routine processes the block coordinate system input into data values and a BCS directory. Data are input to this routine in blank common generated by routine BCSP1. Data leave the routine via blank common.

CALLING SEQUENCE: CALL BCSP1 (NIX, NBSD, NBWD, NBSV, NBEV)

NIX - Length of vector data in blank common input to this routine
NBSV - Starting word of BCS data values in blank common (always 1)
NBEV - Length of BCS data values in blank common
NBSD - Starting word of BCS directory in blank common
NBWD - Length of BCS directory in blank common

REFERENCED BY:

SEGMENT	ROUTINE
BCSRD	BCSRD

FILES: NOUT - System output file

ROUTINE NAME: BCSRD

DESCRIPTION: This routine and the routines that it calls read in and process the user-input BCS DATA block and tie the user-input surface data to the BCS input data. Besides the user BCS data input, this routine reads a random I/O record that was output by the surface data block's pass 2 processor.

CALLING SEQUENCE: CALL BCSRD

KEY VARIABLES: NRIS - Random I/O record number of record written by surface data pass 2 processor
NLIS - Length of the random I/O record

REFERENCED BY:

SEGMENT	ROUTINE
DATARD	DATARD

FILES: NOUT - System output file
NRIO - Random I/O file

ROUTINE NAME: BLDR

DESCRIPTION: This routine drives the sort merge of the BCD form factors input in the form factor data block.

CALLING SEQUENCE: CALL BLDR (NUNIT, NODIN1, NODIN2, NDDOU, NN2, NN, NMAX)

NUNIT - A local variable used by the sort merge to designate the proper output unit
NODIN1, NODIN2, NODOU - Three scratch arrays, NN words long, allocated out of blank common and used to store the working data node i, node j, and value
NN2 - NN * 2
NN - Block size
NMAX - Maximum usable working storage area

REFERENCED BY:

SEGMENT	ROUTINE
FRMFRD	FRMFRD

FILES: NSC3 - Sequential scratch file
NSC2 - Sequential scratch file
NSC1 - Sequential scratch file

ROUTINE NAME: BOX

DESCRIPTION: This routine sets up the Euler angles, position vector, and program-compatible surface description parameters for the top of a five- or six-sided box input by the point method.

CALLING SEQUENCE: CALL BOX (P11, P12, P13, P31, P32, P33)

P11, P12, P13 - X, Y, and Z components of a vector colinear with the surface coordinate system Y-axis

P31, P32, P33 - X, Y, and Z components of a vector colinear with the surface coordinate system X-axis

REFERENCED BY:

SEGMENT	ROUTINE
SDPSS2	SDTPS2

FILES: NOUT - System output file

ROUTINE NAME: BOXGEN

DESCRIPTION: This routine generates Euler angles, position vector, and surface description parameters for the sides and bottom (BOX6) of a box based on similar parameters set up by BOX for the top of the box.

CALLING SEQUENCE: CALL BOXGEN (P11, P12, P13, P31, P32, P33, PHI, PSI, OMG, ISURF)

P11, P12, P13 - X, Y, and Z components of a vector colinear with the surface coordinate system Y-axis

P31, P32, P33 - X, Y, and Z components of a vector colinear with the surface coordinate system X-axis

PHI, PSI, OMG - Euler angles necessary to rotate the ICS, BCS, or CCS into the surface coordinate system

ISURF - Counter indicating which side of box is being generated ($1 \leq$ ISURF ≤ 6)

REFERENCED BY:

SEGMENT	ROUTINE
SDPSS2	SDTPS2

ROUTINE NAME: BSRCHD

DESCRIPTION: This routine performs a table lookup for exact equal compares. The table must be a doublet array and the routine uses the binary search technique.

CALLING SEQUENCE: CALL ISRCHD (NAME, ITABLE, NPAINT, MIDPT, IAN)

NAME - Independent variable name searched for
ITABLE - Doublet table (NAME/ANSWER)
NPOINT - Number of words in the table (2 * number of entries)
MIDPT - Binary midpoint of table (calculated in this routine of MIDPT = 0)
IAN - Dependent variable found (ANSWER)
= 0 if no match is found

REFERENCED BY:

SEGMENT	ROUTINE
INITAL	OPTNRD
SRFCRD	SRFCS1
	CDPRC3
FRMFRD	READVF
SHDWRD	SFTBRD
	SFRSI
FLUXRD	DIBLDR

ROUTINE NAME: CALAC

DESCRIPTION: This is a function subroutine that calculates surface and node areas.

CALLING SEQUENCE: CALAC (ILK, ALPH, BMIN, BMAX, GMIN, GMAX)

ILK - Surface type
1 = Rectangle
2 = Disc
3 = Trapezoid
4 = Cylinder
5 = Cone
6 = Sphere
7 = Paraboloid

ALPH -
BMIN -
BMAX - Surface description parameters
GMIN -
GMAX -

REFERENCED BY:

SEGMENT	ROUTINE
SDPSS2	SDTPS2

ROUTINE NAME: CALANG

DESCRIPTION: Given the direction cosines of SCS X and Y-axis in an ICS, BCS, or CCS, this routine calculates a set of Euler angles to rotate the ICS, BCS, or CCS into the SCS.

CALLING SEQUENCE: CALL CALANG (P11, P12, P13, P31, P32, P33, ROTZ, ROTY, ROTX)

P11, P12, P13 - X, Y, and Z components of a vector with magnitude BMAX that is colinear with the SCS Y-axis

P31, P32, P33 - X, Y, and Z components of a vector with magnitude GMAX that is colinear with the SCS X-axis

ROTZ, ROTY, ROTX - Euler angles to rotate ICS, BCS, or CCS into the SCS

REFERENCED BY:

SEGMENT	ROUTINES	
SDPSS2	BOX	PARAB
	BOXGEN	TRAPZ
	CONE	RECT
	CYLINDER	SPHERE
	DISC	
	IMAGES	

FILES: NOUT - System output file

ROUTINE NAME: CALB

DESCRIPTION: This routine calculates the BMIN and BMAX values for each node.

CALLING SEQUENCE: CALL CALB (DB, BETA, IB, BMAXT, NVB, IG)

DB - Measure of node width in the beta direction

BETA - Measure from the edge of the surface to the center of the current node in the beta direction

IB - Sequence number of current node in the beta direction

BMAXT - Temporary storage of BMAX value for surface

NVB - Number of nodes in the beta direction

IG - Sequence number of current row of nodes in the gamma direction

REFERENCED BY:

SEGMENT	ROUTINE
SDPSS2	SDTPS2

FILES: NOUT - System output file

ROUTINE NAME: CDPRC1

DESCRIPTION: This routine performs the first-pass conversion of a card data input that was read using an "A" format to Hollerith, integer, and floating-point words

CALLING SEQUENCE: CALL CDPRC1

KEY VARIABLES: IND - Array containing the card image data in Hollerith format

NDOT - Array containing the converted values

IDOT - Array describing what is contained in the NDOT array.

JDOT - Column location in which the values in the NDOT array started on with respect to the IND array

ID - A single word containing the number of words used in the NDOT array

REFERENCED BY:

SEGMENT	ROUTINE	SEGMENT	ROUTINE
TRASYS	HCARD	SHOWRD	SHOWRD
QUANRD	QUANRD		SFTBRD
ARRYRD	ARRYRD	FLUXRD	FLUXRD
SKIRD	SKIRD		DIBLOR
	KP1	CRSPRD	CRSPRD
	IP1	LOGIC1	LP1
	SRFCRD	SRFCRD	ORBGEN
	SRFCS1	LOGIC2	LOGIC2
	SRFCBC	LOGIC3	LOGIC3
BCSRD	BCSP1		
FRMFRD	FRMFRD		
	READVF		

FILES: NOUT - System output file

ROUTINE NAME: CDPRC2

DESCRIPTION: This routine processes the arithmatic calculations (*, 1, -, +) within a data field input on a user input card. This routine is usually called after subroutine CDPRC1, but in some instances it is called after CDPRC3.

CALLING SEQUENCE: CALL CDPRC2

KEY VARIABLES: NDOT, IDOT, JDOT and ID have the same function in this routine as they do in CDPRC1. This routine may or may not condense the arrays, depending on the type of input.

REFERENCED BY:

SEGMENT	ROUTINE
TRASYS	HCARD
QUANRD	QUANRD
ARRYRD	ARRYRD
SKIRD	SKIRD
	KP1
	IP1
SRFCRD	SRFCRD
	SRFCS1
	SRFCBC
BCSRD	BCSF1
FRMFRD	FRMFRD
	READVF
SHOWRD	SHOWRD
	SFTBRD
FLUXRD	FLUXRD
	DIBLDR
CRSPRD	CRSPRD
LOGIC1	ORBGEN

FILES: NOUT - System output file

ROUTINE NAME: CDPRC3

DESCRIPTION: This routine compares all Hollerith words in the NDOT array to a directory array residing in the dynamic storage area for a matching name. If it finds one, then the name in the NDOT array is replaced by the corresponding data value or values. This routine should be called after CDPRC1 and before CDPRC2.

CALLING SEQUENCE: CALL CDPRC3

KEY VARIABLES:

NDOT - Output array from CDPRC1 and input for this routine. Also the output from this routine

IDOT & JDOT - Same as NDOT

IX - Dynamic storage (blank common), containing the constant directory and constant data

IXSD - Index pointing to first word of directory

IXWD - Length of directory

IXSV - Index pointing to first word of data values

REFERENCED BY:

SEGMENT	ROUTINE
SRFCRD	SRFCS1

FILES: NOUT - System output file

ROUTINE NAME: CHEC

DESCRIPTION: This routine checks the validity of surface description parameter values.

CALLING SEQUENCE: CALL CHEC

REFERENCED BY:

SEGMENT	ROUTINE
SDPSS2	SDTPS2

FILES: NOUT - System output file

ROUTINE NAME: CM30

DESCRIPTION: This routine name is an entry point into the routine WCOM. When this entry point name is called, the Fortran-labeled common for the processor FFPROG segment is written to the NCMPL file.

CALLING SEQUENCE: CALL CM30

REFERENCED BY:

SEGMENT	ROUTINE
LOGICO	WPROG
LOGIC3	LOGIC3

FILES: NCMPL - The file that the generated processor Fortran cards are written to

ROUTINE NAME: CM40

DESCRIPTION: This routine name is an entry point into the routine WCOM. When this entry point name is called, the Fortran-labeled common for the processor SFPROG segment is written to the NCMPL file.

CALLING SEQUENCE: CALL CM40

REFERENCED BY:

SEGMENT	ROUTINE
LOGICO	WPROG
LOGIC3	LOGIC3

FILES: NCMPL - The file that the generated processor Fortran cards are written to

ROUTINE NAME: CM50

DESCRIPTION: This routine name is an entry point into the routine WCOM. When this entry point is called, the Fortran-labeled common for the processor NPPROG segment is written to the NCMPL file.

CALLING SEQUENCE: CALL CM50

REFERENCED BY:

SEGMENT	ROUTINE
LOGICO	SPROG
LOGIC3	LOGIC3

FILES: NCMPL - The file that the generated processor Fortran cards are written to

ROUTINE NAME: CM60

DESCRIPTION: This routine name is an entry point into the routine WCOM. When this entry point name is called, the Fortran-labeled common for the processor ODPROG segment is written to the NCMPL file.

CALLING SEQUENCE: CALL CM60

REFERENCED BY:

SEGMENT	ROUTINE
LOGICO	WPROG
LOGIC3	LOGIC3

FILES: NCMPL - The file that the generated processor Fortran cards are written to

ROUTINE NAME: CM70

DESCRIPTION: This routine name is an entry point into the routine WCOM. When the entry point is called, the Fortran-labeled common for the processor DIPROG segment is written to the NCMPL file.

CALLING SEQUENCE: CALL CM70

REFERENCED BY:

SEGMENT	ROUTINE
LOGICO	WPROG
LOGIC3	LOGIC3

FILES: NCMPL - The file that the generated processor Fortran cards are written to

ROUTINE NAME: CM80

DESCRIPTION: This routine name is an entry point into the routine WCOM. When this entry point name is called, the Fortran-labeled common for the processor GBPROG segment is written to the NCMPL file.

CALLING SEQUENCE: CALL CM80

REFERENCED BY:

SEGMENT	ROUTINE
LOGICO	WPROG
LOGIC3	LOGIC3

FILES: NCMPL - The file that the generated processor Fortran cards are written to

ROUTINE NAME: CM90

DESCRIPTION: This routine name is an entry point into the routine WCOM. When this entry point name is called, the Fortran-labeled common for the processor RKPROG segment is written to the NCMPL file.

CALLING SEQUENCE: CALL CM90

REFERENCED BY:

SEGMENT	ROUTINE
LOGICO	WPROG
LOGIC3	LOGIC3

FILES: NCMPL - The file that the generated processor Fortran cards are written to

ROUTINE NAME: CM100

DESCRIPTION: This routine name is an entry point into the routine WCOM. When this entry point name is called, the Fortran-labeled common for the processor FFPRØG segment is written to the NCMPL file.

CALLING SEQUENCE: CALL CM100

REFERENCED BY:

SEGMENT	ROUTINE
LOGICO	WPROG
LOGIC3	LOGIC3

FILES: NCMPL - The file that the generated processor Fortran cards are written to

ROUTINE NAME: CM110

DESCRIPTION: This routine name is an entry point into the routine WCOM. When this entry point name is called, the Fortran-labeled common for the processor QOPROG segment is written to the NCMPL file.

CALLING SEQUENCE: CALL CM110

REFERENCED BY:

SEGMENT	ROUTINE
LOGICO	WPROG
LOGIC3	LOGIC3

FILES: NCMPL - The file that the generated processor Fortran cards are written to

ROUTINE NAME: CM120

DESCRIPTION: This routine name is an entry point into the routine WCOM When the entry point name is called, the Fortran-labeled common for the processor DRPROG segment is written to NCMPL file.

CALLING SEQUENCE: CALL CM120

REFERENCED BY:

SEGMENT	ROUTINE
LOGICO	WPROG
LOGIC3	LOGIC3

FILES: NCMPL - The file that the generated processor Fortran cards are written to

ROUTINE NAME: CM140

DESCRIPTION: The routine name is an entry point into the routine WCOM. When this entry point name is called, the Fortran-labeled common for the processor RCPROG segment is written to the NCMPL file.

CALLING SEQUENCE: CALL CM140

REFERENCED BY:

SEGMENT	ROUTINE
LOGICO	WPROG
LOGIC3	LOGIC3

FILES: NCMPL - The file that the generated processor Fortran cards are written to

ROUTINE NAME: CM150

DESCRIPTION: This routine name is an entry point into the routine WCOM. When this entry point name is called, the Fortran-labeled common for the processor DRPROG segment is written to the NCMPL file.

CALLING SEQUENCE: CALL CM150

REFERENCED BY:

SEGMENT	ROUTINE
LOGIC0	WPROG
LOGIC3	LOGIC3

FILES: NCMPL - The file that the generated processor Fortran cards are written to

ROUTINE NAME: CONE

DESCRIPTION: This routine converts point input for cones to program-compatible surface description parameters and sets up Euler angles and a position vector to transform the ICS, BCS, or CCS into the SCS of the cone.

CALLING SEQUENCE: CALL CONE

REFERENCED BY:

SEGMENT	ROUTINE
SDPSS2	SDTPS2

FILES: NOUT - System output file

ROUTINE NAME: COPYM

DESCRIPTION: This routine copies a specified model in source edit format from a user-specified file to the NEMG file.

CALLING SEQUENCE: CALL COPYM (NU, N)

NU - File to be copied from
N - Name of model to be copied

REFERENCED BY:

SEGMENT	ROUTINE
MCOLL	MCOLL

FILES: NU - User-specified file
NEMG - Edit merge file
NOUT - System output file

ROUTINE NAME: CRSPRD

DESCRIPTION: This routine and the routines that it calls read in and process the user's CORRESPONDENCE DATA block.

CALLING SEQUENCE: CALL CRSPRD

REFERENCE:

SEGMENT	ROUTINE
DATARD	DATARD

FILES: NGBIRR - Contains the correspondence data output from this routine for the processor phase
NOUT - System output file

ROUTINE NAME: CYLNDR

DESCRIPTION: This routine converts point input for cylinders to program-compatible surface description parameters and sets Euler angles and a position vector to transform the ICS, BCS, or CCS into the SCS of the cylinder.

CALLING SEQUENCE: CALL CYLNDR

REFERENCED BY:

SEGMENT	ROUTINE
SDPSS2	SDTPS2

FILES: NOUT - System output file

ROUTINE NAME: DATARD

DESCRIPTION: This routine is the driving segment that calls the other segments that read in and process the data blocks of the user's input data deck. It does not read in the logic blocks.

CALLING SEQUENCE: CALL DATARD

REFERENCED BY:

SEGMENT	ROUTINE
TRASYS	TRASYS

FILES: NOUT - System output file

ROUTINE NAME: DATE (CDC system routine)

DESCRIPTION: This routine returns the current date that the job was run on the computer. The date is returned in displayed code in the following format....

bMM/DD/YY.

CALLING SEQUENCE: CALL DATE (DTE)

DTE - Returned data variable

REFERENCED BY:

SEGMENT	ROUTINE
INITAL	INITAL

ROUTINE NAME: DCMNRD

DESCRIPTION: This routine processes the user-input documentation data block.

CALLING SEQUENCE: CALL DCMNRD

REFERENCED BY:

SEGMENT	ROUTINE
DATARD	DATARD

FILES: NOUT - System output file

ROUTINE NAME: DDUMP

DESCRIPTION: This routine prints consecutive core memory words to the system output file in octal format. This routine is used to dump the error trace information of the preprocessor.

CALLING SEQUENCE: CALL DDUMP (ISADD, IEADD, NN)

ISADD - Address of word to start dumping
IEADD - Address of word to end dumping
NN - Integer number to print to identify the printed dump

REFERENCED BY:

SEGMENT	ROUTINE	SEGMENT	ROUTINE	SEGMENT	ROUTINE
SEDIT	SEDIT	SKIRD	SKIRD	CRSPRD	CRSPRD
	EPTAPE		IP2		
	OTWTE		IP2	LOGIC1	LOGIC1
GNEDO	GNEDO	SRFCRD	SRFCRD		
QUANRD	QUANRD		SRFCS1		LP1
		BCSRD	BCSRD	TPGEN	TPGEN
	QUANSD				
ARRYRD	ARRYRD	SHDWRD	SHDWRD		
			SFTBRD		
			SFRSI		
			SFWPL		
			SFCIO		

FILES: NOUT - System output file

ROUTINE NAME: DIBLDR

DESCRIPTION: This routine process one set of user's flux data input in the FLUX DATA input block. The output of this routine is the flux data restart file, NDIR.

CALLING SEQUENCE: CALL DIBLDR (NODIN, IQDS, IQDR, IQDP, NN, NN2, INIT, ISTEP)

NODIN - Starting location for the unsorted node array
IQDS - Starting location for the solar data
IQDR - Starting location for the albedo data
IQDP - Starting location for the planetary data
NN - Number of nodes in the node array
NN2 - Number of words in the node directory (2 * NN)
INIT - Value to initialize the IQDS, IQDR, IQDP arrays to
ISTEP - Logic block step number to which this set of flux data pertains

REFERENCES: SEGMENT	ROUTINE
FLUXRD	FLUXRD

FILES: NOUT - System output file
NDIR - Flux data restart file

ROUTINE NAME: DIRCS

DESCRIPTION: Given the Euler angles necessary to rotate one coordinate system into another, this routine calculates the cooresponding direction cosines.

CALLING SEQUENCE: CALL DIRCS (II, JJ, KK, PHI, PSI, OMI, TRAN)

II, JJ, KK - Integers (1, 2, or 3) defining the order in which the rotations PHI, PSI, and OMI are to be performed
PHI, PSI, OMI - Euler angles defining the rotations about the Z, Y, and X-axes, respectively
TRAN - A three-by-three matrix of direction cosines

REFERENCES: SEGMENTS	ROUTINES
SKIRD	IP1
SDPSS2	SDTPS2
	BOX
	IMAGES

ROUTINE NAME: DISC

DESCRIPTION: This routine converts point input for discs to program-compatible surface description parameters and sets up Euler angles and a position vector to transform the ICS, BCS, or CCS into the SCS of the disc.

CALLING SEQUENCE: CALL DISC

REFERENCED BY:

SEGMENT	ROUTINE
SDPSS2	SDTPS2

FILES: NOUT - System output file

ROUTINE NAME: DUPSRF

DESCRIPTION: This routine duplicates previously input surfaces and modifies surface description parameters as specified by the user.

CALLING SEQUENCE: CALL DUPSRF (ISSX, IESX, IER)

ISSX - The index of the starting location where previously input surface descriptions are loaded into blank common

IESX - The index of the location of the end of the surface description data in blank common for a previously input surface

IER - An indicator of errors encountered

REFERENCED BY:

SEGMENT	ROUTINE
SRFCRD	SRFCS1

FILES: NOUT - System output file
NRIOS - Scratch random access file

ROUTINE NAME: EPTAPE

DESCRIPTION: This routine positions the NEDI file at the beginning of the requested model so that source editing of the user's data can begin.

CALLING SEQUENCE: CALL EPTAPE (NU, NAME, IER)

NEDI - Source edit input file
NAME - Name of model requested for editing
IER - Error return flag
= 0 Ready for editing
≠ 0 Not ready for editing

REFERENCED BY:

SEGMENT	ROUTINE
SEDIT	SEDIT

FILES: NOUT - System output file
NEDIT - Source edit input file

ROUTINE NAME: FDPRC

DESCRIPTION: This routine does the **, *, /, +, - calculations between constants input within a single data field on a user-input data card.

CALLING SEQUENCE: CALL FDPRC (IPL, IPR, NWP)

IPL - Starting location within NDOT array to start performing calculations
IPR - Ending location to stop processing calculations
NWP - Number of words left after calculation processing that contains data within the data field processed

REFERENCED BY:

SEGMENT	ROUTINE
TRASYS	CDPRC2

FILES: NOUT - System output file

ROUTINE NAME: FINAL

DESCRIPTION: This routine generates the form factor request matrix on the FFR restart form factor file for use in the processor segment. The entire matrix is defined as a "-1" or the data input by the user. A "-1" means recompute the form factor.

CALLING SEQUENCE: CALL FINAL (NUNIT, NODE, NODOU, DATA, RINIT, ISTEP, NN, NN2)

NUNIT - Unit containing sorted - blocked form factor data
NODE - Input array of node numbers
NODOU, DATA - Working arrays defined in blank common
RINIT - User-input initial value for the matrix
ISTEP - User-input step number as to where to store the restart data
NN - Number of nodes
NN2 - 2 * NN

REFERENCED BY:

SEGMENT	ROUTINE
FRMFRD	FRMFRD

RILES: NFFR - Form factor restart file

ROUTINE NAME: FLUXRD

DESCRIPTION: This routine and the routines that it calls read in and process the user's input FLUX DATA block.

CALLING SEQUENCE: CALL FLUXRD

REFERENCED BY:

SEGMENT	ROUTINE
DATARD	DATARD

FILES: NOUT - System output file

ROUTINE NAME: FRMFRD

DESCRIPTIONS: This routine and the routines that it calls read in and process the user's FORM FACTOR DATA block.

CALL SEQUENCE: CALL FRMFRD

REFERENCED BY:

SEGMENT	ROUTINE
DATARD	DATARD

FILES: NOUT - System output file
NSC2 - TRASYS scratch file

ROUTINE NAME: GNEDO

DESCRIPTION: This routine generates the source edit output file if the user requests one to be generated

CALLING SEQUENCE: CALL GNEDO

REFERENCED BY:

SEGMENT	ROUTINE
START	START

FILES: NOUT - System output file
NEDI - Input source edit file
NEDO - Output source edit file
NDI - Current model source data file

ROUTINE NAME: HCARD

DESCRIPTION: This routine decodes the header cards of the user's input data deck when the card is read from the NDI file.

CALLING SEQUENCE: CALL HCARD (N)

N = 1 Card to be processed has been read prior to calling this routine
N = 0 Card is to be read before processing

REFERENCED BY:

SEGMENT	ROUTINE
START	HEADCD
INITAL	OPTNRD
SEDIT	SEDIT
DATARD	DATARD
QUANRD	QUANRD
ARRYRD	ARRYRD
SKIRD	SKIRD
SRFCRD	SRFCRD
	SRFCS1
	SRFCBC
BCSRD	BCSRD
DCMNRD	DCMNRD
FRMFRD	FRMFRD
	READVF
SHOWRD	SHOWRD
	SFTBRD
FLUXRD	FLUXRD
	DIBLDR
CRSPRD	CRSPRD
LOGIC1	LP1
LOGIC3	LOGIC3

FILES: NOUT - System output file

ROUTINE NAME: HEADCD

DESCRIPTION: This routine decodes the HEADER cards of the user input data deck when the card is to be read directly from the system input file.

CALLING SEQUENCE: CALL HEADCD (N)

N = 1 Card to be processed has been read prior to calling this routine
N = 0 Card is to be read before processing

REFERENCED BY:

SEGMENT	ROUTINE
INITAL	INITAL
MCOLL	MCOLL

FILES: NIN - System input file
NOUT - System output file

ROUTINE NAME: HTI

DESCRIPTION: This routine converts a Hollerith word containing a positive integer number to an integer number.

CALLING SEQUENCE: CALL HTI (IN, IOUT, IFLAG)

IN - Word to be converted
IOUT - Converted word
IFLAG - = 0 Conversion was complete
= 1 Conversion was not complete

REFERENCED BY:

SEGMENT	ROUTINE
INITAL	OPTNRD

ROUTINE NAME: H10T6

DESCRIPTION: This routine converts a string of 10 character Hollerith words to a string of 6 character Hollerith words.

CALLING SEQUENCE: CALL H10T6 (NID, ICØM, NW)

NID - starting location in the IX array (dynamic storage) to start processing
ICØM - Starting location to store processed data
NW - Number of 10-character words to process

REFERENCED BY:

SEGMENT	ROUTINE
INITAL	OPTNRD

ROUTINE NAME: <u>IMAGES</u>

DESCRIPTION: This routine images previously input surfaces in reference planes that have been set up by subroutine REFCD and writes the surface description data for the images on the random access file.

CALLING SEQUENCE: CALL IMAGES (ISAVE, NOSF, NOND, IMAG, IREF, NLEN, INDEXS, INDEXN, IER)

ISAVE - An array of previously input surface numbers and their corresponding random access file record numbers

NOSF - Surface counter (sequence number)

NOND - Node counter (sequence number)

IMAG - ID number of previously input surface that is to be imaged

IREF - ID number of reference plane in which IMAG is to be imaged

NLEN - Length of a random access record

INDEXS - An array of random access record numbers for surfaces

INDEXN - An array of random access record numbers for surfaces

IER - An indicator of errors encountered

REFERENCED BY:

SEGMENT	ROUTINE
SDPSS2	SDTPS2

FILES: NOUT - System output file
NRIO - Random access file

ROUTINE NAME: <u>INITAL</u>

DESCRIPTION: This routine initializes the preprocessor-labeled common, and calls the routines to write the TRASYS banner on the system output file and read in the OPTION DATA block.

CALLING SEQUENCE: CALL INITAL

REFERENCED BY:

SEGMENT	ROUTINE
START	START

ROUTINE NAME: <u>INRDB</u>

DESCRIPTION: This subroutine name is an entry point into routine INRDD.

CALLING SEQUENCE: CALL INRDB

REFERENCED BY:

SEGMENT	ROUTINE
BCSRD	BCSRD BCSP1

ROUTINE NAME: <u>INRDD</u>

DESCRIPTION: This routine reads in the NDI file that contains the user-input data cards.

CALLING SEQUENCE: CALL INRDD
CALL INRDB
CALL INRDO
CALL INRDDC } Entry Points
CALL INRDSF
CALL INRDOD

REFERENCED BY:

SEGMENT	ROUTINE	SEGMENT	ROUTINE
TRASYS	HCARD	SRFCRD	SRFCRD
QUANRD	QUANRD		SRFCS1
ARRYRD	ARRAYRD		SRFCBC
SKIRD	SKIRD	CBSPRD	CRSPRD
	KP1		
	IP1		

FILES: NOUT - System output file
NDI - Current model source data file

ROUTINE NAME: <u>INRDE</u>

DESCRIPTION: This routine reads in the NEDI file for the TRASYS source editor.

CALLING SEQUENCE: CALL INRDE

REFERENCED BY:

SEGMENT	ROUTINE
SEDIT	SEDIT

FILES: NEDI - Input source edit data file
NOUT - System output file

ROUTINE NAME: INRDO

DESCRIPTION: This subroutine name is an entry point into routine INRDD.

CALL SEQUENCE: CALL INRDO

REFERENCED BY:

SEGMENT	ROUTINE
FRMFRD	FRMFRD READVF
FLUXRD	FLUXRD DIBLDR
LOGIC3	LOGIC3

ROUTINE NAME: INRDOD

DESCRIPTION: This subroutine name is an entry point into routine INRDD.

CALLING SEQUENCE: CALL INRDOD

REFERENCED BY:

SEGMENT	ROUTINE
LOGIC1	LP1

ROUTINE NAME: INRDPP

DESCRIPTION: This routine reads in the NDI file for the source editor print/punch routine.

CALLING SEQUENCE: CALL INRDPP

REFERENCED BY:

SEGMENT	ROUTINE
SEDIT	PTPHSF

FILES: NDI - Input source edit data file

ROUTINE NAME: INRDSF

DESCRIPTION: This subroutine name is an entry point into the subroutine INRDD.

CALLING SEQUENCE: CALL INRDSF

REFERENCED BY:

SEGMENT	ROUTINE
SHDWRD	SHDWRD SFTBRD

ROUTINE NAME: IP1

DESCRIPTION: This routine performs the first-pass processing of the intermediate coordinate system input cards that the user input in the SURFACE DATA block.

CALLING SEQUENCE: CALL IP1 (NIX)

NIX - Index of the last word used in the dynamic storage array (IX) on completion of this routine.

REFERENCED BY:

SEGMENT	ROUTINE
SKIRD	SKIRD

FILES: NOUT - System output file

ROUTINE NAME: IP2

DESCRIPTION: This routine performs the second-pass processing of the intermediate coordinate system input data that the user input in the SURFACE DATA block.

CALLING SEQUENCE: CALL IP2 (NIX)

NIX - Index of the last word in dynamic storage containing the data generated and passed by IP1.

KEY VARIABLES:

NISV - Index of the starting word in dynamic storage that contains the output intermediate coordinate data

NIEV - Index of the last word in dynamic storage that contains the output intermediate coordinate data

NISD - Index of the starting word in dynamic storage that contains the output intermediate coordinate directory

NIWD - Length of the intermediate coordinate directory

REFERENCES:

SEGMENT	ROUTINE
SKIRD	SKIRD

FILES: NOUT - System output file

ROUTINE NAME: JOBNO (CDC system routine)

DESCRIPTION: This routine returns the current job number of the job as the computer knows it. The job number is returned in display code in the following format:

UUUUUCCbb

where UUUUU are user-assigned and cc are computer-assigned.

CALLING SEQUENCE: CALL JOBNO (N)

N = Returned variable for job number

REFERENCED BY:

SEGMENT	ROUTINE
INITAL	INITAL

ROUTINE NAME: KP1

DESCRIPTION: This routine performs the first-pass processing of the constant input cards the user inputs in the SURFACE DATA blocks.

CALLING SEQUENCE: CALL KP1 (NKREC, NKNAM, NKVAL, IBUF)

NKREC - Number of records written to the NSC1 file

NKVAL - Total number of constant values, including the integer count

NKNAM - The number of constant names

IBUF - Scratch array that may or may not be used as a communication disk between routine KP1 and KP2

ENTRY POINT: CALL KP1E (NKREC, IBUF)

This entry point is called when all constant cards have been read and the IBUF array is to be flushed to file NSC1.

REFERENCED BY:

SEGMENT	ROUTINE
SKIRD	SKIRD

FILES: NOUT - System output file

NSC1 - Scratch file 1 used to communicate between routines KP1 and KP2

ROUTINE NAME: KP1E

DESCRIPTION: This name is an entry point into routine KP1 and is called to flush the IBUF array when the last constant data card has been processed.

CALLING SEQUENCE: CALL KP1E (NKREC, IBUF)

NKREC - Number of records written to the NSC1 file
IBUF - Scratch array that may or may not be used as a communication link between routines KP1 and KP2

REFERENCED BY:

SEGMENT	ROUTINE
SKIRD	SKIRD

FILES: NSC1 - Scratch file 1 used to communicate between routines KP1 and KP2

ROUTINE NAME: KP2

DESCRIPTION: This routine performs the second-pass processing of the constant input cards the user inputs in the SURFACE DATA blocks.

CALLING SEQUENCE: CALL KP2 (NKREC, NKNAM, NKUAL, IBUF)

Argument description is same as for routine KP1.

KEY VARIABLES:
NKSD - Index of the starting word in dynamic storage that contains the output constant data
NKWD - Length of the constants directory
KKSV - Index of the starting word in dynamic storage that contains the output constant values
NKEV - Index of the last word in dynamic storage that contains the output constant values

REFERENCED BY:

SEGMENT	ROUTINE
SKIRD	SKIRD

FILES: NOUT - System output file
NSC1 - Scratch file 1 used to communicate between routines KP1 and KP2

ROUTINE NAME: LFILL

DESCRIPTION: This routine left-justifies a word that is filled with zeros to the left of the data.

CALLING SEQUENCE: I = LFILL (IN, IFILL)

IN - Word to be left-justified
IFILL - The character to fill the word with right of the data

REFERENCED BY:

SEGMENT	ROUTINE	SEGMENT	ROUTINE
TRASYS	ABT1	QUANRD	QUANRD
	CDPRC1	ARRYRD	ARRYRD
	PTSVER	SKIRD	SKIRD
INITAL	OPTNRD		IP1
		SRFCRD	SRFCS1
			CDPRC3
		BCSRD	BCSRD
	H10T6		BCSP1
	UNITCG	SHDWRD	SHDWRD
MCOLL	MCOLL	LOGIC1	LOGIC1
SEDIT	SEDIT		

ROUTINE NAME: LLSF (CDC system routine)

DESCRIPTION: This routine is a function that left-shifts a word with rap-a-round on the pushoff bits. It is usually a system routine.

CALLING SEQUENCE: I = LLSF (IWORD, IBITS)

IWORD - Word to be left-shifted
IBITS - Number of bits to shift

REFERENCED BY:

SEGMENT	ROUTINE	SEGMENT	ROUTINE	SEGMENT	ROUTINE
TRASYS	HCARD	SEDIT	SEDIT	BCSRD	BCSRD
	INRDD				BCSP1
	CDPRC1				BCSP2
	LFILL		ASKCRD	DCMNRD	DCMNRD
	PTSVER		PTPHSF	FRMFRD	FRMFRD
	BSRCHD	QUANRD	QUANRD		READVF
START	HEADCD	ARRYRD	ARRYRD	SHDWRD	SHDWRD
INITAL	OPTNRD	SKIRD	SKIRD		SFTBRD
	HTI		KP1	FLUXRD	FLUXRD
	H10T6	SRFCRD	SRFCRD		DIBLDR
	OPTNCV		SRFCS1	CRSPRD	CRSPRD
MCOLL	MCOLL		CDPRC3	LOGIC1	LP1
	MCOLCV	SDPSS2	SDTPS2	LOGIC2	LOGIC2
			IMAGES	LOGIC3	LOGIC3

ROUTINE NAME: LOCF (CDC system routine)

DESCRIPTION: This routine is a function that returns the absolute memory word address of the argument passed to it. The routine is usually a Fortran-callable system routine.

CALLING SEQUENCE: I = LOCF (J)

J = The word whose address is wanted

REFERENCED BY:

SEGMENT	ROUTINE
TRASYS	WSCOPE
	DDUMP
	BUFCOR
START	ALTFILE
INITAL	INITAL
SKIRD	IP2
	KP2
SDPSS2	SDPSS2
BCSRD	BCSP2
RAPUP	RAPUP

ROUTINE NAME: LOGICO

DESCRIPTION: This routine is the controlling driver for the processing of the user's logic block input

CALLING SEQUENCE: CALL LOGICO

REFERENCED BY:

SEGMENT	ROUTINE
TRASYS	TRASYS

FILES: NOUT - System output file

ROUTINE NAME: LOGIC1

DESCRIPTION: This routine and the routines that it calls read in the array, quantities, and BCS directories. It then checks for duplicate names between the directories and reserve variable list and creates the common array consisting of names that will be used to write the processor common arrays. This routine also reads in the user's OPERATION DATA block and counts the step cards and the substep cards within a step. This information will be used to create the computed GO TO statements in routine LOGIC2.

CALLING SEQUENCE: CALL LOGIC1

REFERENCED BY:	SEGMENT	ROUTINE
	LOGICO	LÓGICO

FILES: NOUT - System output file
NRIO - Preprocessor and processor random I/O communication file

ROUTINE NAME: LOGIC2

DESCRIPTION: This routine generates the main program segment of the processor and also reads in the OPERATION DATA output from routine LP1 and processes it into valid Fortran routine. These routines are written to file NCMPL as valid Fortran routines.

CALLING SEQUENCE: CALL LOGIC2

REFERENCED BY:	SEGMENT	ROUTINE
	LOGICO	LOGICO

FILES: NOUT - System output file
NSC1 - Scratch file containing user's operation data output by routine LP1
NCMPL - The file that the generated processor Fortran card are written to

ROUTINE NAME: LOGIC3

DESCRIPTION: This routine and the routines that it calls read in and process the user's SUBROUTINE DATA block. This routine also writes all of the primary routines of all the segments, along with the user-input subroutines to the NCMPL file.

CALLING SEQUENCE: CALL LOGIC3

REFERENCED BY:

SEGMENT	ROUTINE
LOGICO	LOGICO

FILES: NOUT - System output file
NCMPL - The file that the generated processor Fortran cards are written to

ROUTINE NAME: LP1

DESCRIPTION: This routine reads the user's OPERATION DATA block in pass 1 for the number of steps and number of substeps within a step. The ORBGEN user-input card is also expanded in this routine to standard type of input. The step directory is written to file NRIO.

CALLING SEQUENCE: CALL LP1

REFERENCED BY:

SEGMENT	ROUTINE
LOGIC1	LOGIC1

FILES: NOUT - System output file
NSC1 - Scratch file which the operation data block cards are written to for pass 2 processing
NRIO - Preprocessor and processor random I/O communication file

ROUTINE NAME: LRSF

DESCRIPTION: This routine is a function that right-shifts a word with sign extension. This routine is usually a system function.

CALLING SEQUENCE: I = LRSF (IWORD, IBITS)

IWORD = Word to be right-shifted
IBITS = Number of bits to shift

REFERENCED BY:

SEGMENT	ROUTINE
TRASYS	ABT1
	BSRCHD
INITAL	OPTNRD
QUANRD	QUANRD
ARRYRD	ARRYRD
SKIRD	KP1
SRFCRD	SRFCS1
BCSRD	BCSRD
FRMFRD	FINAL
	SORTDB
SHDWRD	SFUNPK
	SFTBRD
FLUXRD	DIBLDR

ROUTINE NAME: MERGC

DESCRIPTION: This routine processes the CMERG source editor directives. Once the CMERGE card is decoded, the NCMG file is searched to find the requested file and cards, and the requested cards are then written to the NDI file.

CALLING SEQUENCE: CALL MERGC (NCARD)

NCARD = Last new edit sequence number used

REFERENCED BY:

SEGMENT	ROUTINE
SEDIT	SEDIT

FILES: NOUT - System output file
NCMG - User-input card image supplementary input file

ROUTINE NAME: MERGE

DESCRIPTION: This routine processes the EMERG source editor directives. Once the EMERG card is decoded, the NEMG file is searched for the requested model and cards, and the requested cards are then written to the NDI file.

CALLING SEQUENCE: CALL MERGE (NCARD)

NCARD = Last new edit sequence number used

REFERENCED BY:

SEGMENT	ROUTINE
SEDIT	SEDIT

FILES: NOUT - System output file
NEMG - User-input source edit-formatted supplementary input file

ROUTINE NAME: MERGF

DESCRIPTION: This routine merges the data on two files and generates a third file containing the entire set of data in a sorted format.

CALLING SEQUENCE: CALL MERGF (M1, M2, MOUT, IA, IB, IC, IOUTT)

M1 - Input unit number
M2 - Input unit number
MOUT - Output unit number
IA, IB, IC, IOUTT - Working arrays

REFERENCED BY:

SEGMENT	ROUTINE
FRMFRD	BLDR

FILES:
NOUT - System output file
NSC1 - Scratch file tape 1, set up in routine BLDR
NSC2 - Scratch file tape 2, set up in routine BLDR
NSC3 - Scratch file tape 3, set up in routine BLDR

ROUTINE NAME: NONDF

DESCRIPTION: This routine, when given the internal sequence number of the node, returns the node number.

CALLING SEQUENCE: I = NONDF (NN)

REFERENCED BY:

SEGMENT	ROUTINE
SDPSS2	SDTPS2 IMAGES AUTOCM STUFDT

ROUTINE NAME: OPENMS (CDC system routine)

DESCRIPTION: This routine opens a mass storage random I/O file.

CALLING SEQUENCE: CALL OPENMS (U, IX, LNGTH, T)

U - Unit designator
IX - First word address in central memory of the array that will contain the file index
LNGTH - Length of the index
LNGTH - (no. of records +1) for number index.
LNGTH - 2 * (no. of records +1) for name index
T - T = 0 file is referenced through a number master index
T = 1 file is referenced through a name master index (TRASYS uses only a numbered index)

REFERENCED BY:

SEGMENT	ROUTINE
INITAL	INITAL
SRFCRD	SRFCRD
SHDWRD	SHDWRD

ROUTINE NAME: OPTNCV

DESCRIPTION: This routine decodes the user's input cards that are input in the OPTION DATA block.

CALLING SEQUENCE: CALL OPTNCV

REFERENCED BY:

SEGMENT	ROUTINE
INITAL	OPTNRD

ROUTINE NAME: OPTNRD

DESCRIPTION: This routine reads in and processes the user-input OPTION DATA block.

CALLING SEQUENCE: CALL OPTNRD

REFERENCED BY:

SEGMENT	ROUTINE
INITAL	INITAL

FILES: NOUT - System output file
NIN - System input file

ROUTINE NAME: ORBGEN

DESCRIPTION: This routine and the routines that it calls process the user's logic input ORBGEN card.

REFERENCED BY:

SEGMENT	ROUTINE
LOGIC1	LP1

FILES: NOUT - System output file
NSC1 - Scratch file that the output of logic pass 1 is written to

ROUTINE NAME: ORBIN

DESCRIPTION: This routine writes the operations data block code for automatic generation of inertial (sun or star) oriented orbits.

CALLING SEQUENCE: CALL ORBIN (IREP, TRU, DVC, NPOINT, ILORC)

IREP - Repeat flag for complete orbits
TRU - Initial true anomaly
DV6 - True anomaly increment
NPOINT - Number of orbit points generated
ILORC - Flag to eliminate AQCAL calls from operations data block code

REFERENCED BY:

SEGMENT	ROUTINE
LOGIC1	ORBGEN

FILES: NOUT - System output file
NSC1 - Scratch file that the output of logic pass 1 is written to

ROUTINE NAME: ORBNPL

DESCRIPTION: This routine writes the operations data block code for automatic generation of heliocentric orbits.

CALLING SEQUENCE: CALL ORBNPL (IREP, TRU, DVL, NPOINT, ILORC)

IREP - Repeat flag for complete orbits
TRU - Initial true anomaly
DV6 - True anomaly increment
NPOINT - Number of orbit points generated
ILORC - Flag to eliminate AQCAL calls from operations data block code

REFERENCED BY:

SEGMENT	ROUTINE
LOGIC1	ORBGEN

FILES: NOUT - System output file
NSC1 - Scratch file that the output of logic pass 1 is written to

ROUTINE NAME: ORBPL

DESCRIPTION: This routine writes the operations data block code for automatic generation of noncircular, planet-oriented orbits.

CALLING SEQUENCE: CALL ORBPL (IREP, TRU, DV6, NPOINT, ILORC)

IREP TRU DV6 NPOINT ILORC	Reference ORBIN

REFERENCED BY:

SEGMENT	ROUTINE
LOGIC1	ORBGEN

FILES: NOUT - System output file
NSC1 - Scratch file that the output of logic pass 1 is written to

ROUTINE NAME: ORBPLC

DESCRIPTION: This routine writes the operations data block code for automatic generation of circular, planet-oriented orbits.

CALLING SEQUENCE: CALL ORPLC (IREP, TRU, DV6, NPOINT, ILORC)

IREP TRU DV6 NPOINT ILORC	Reference ORBIN

REFERENCED BY:

SEGMENT	ROUTINE
LOGIC1	ORBGEN

FILES: NOUT - System output file
NSC1 - Scratch file that the output of logic pass 1 is written to

ROUTINE NAME: OTWTE

DESCRIPTION: This routine writes the NDI file called by the TRASYS source editor.

CALLING SEQUENCE: CALL OTWTE (IFLUSH)

IFLUSH = 0 Not the last call to this routine
IFLUSH = 1 The last call to this routine. Flush the IOB array to the NDI file

KEY VARIABLES: IOB - An array used for collecting card images until IOT words have been filled
IOT - Last word to fill in the IOB array before flushing the data to the NDI file

REFERENCED BY:

SEGMENT	ROUTINE
SEDIT	SEDIT
	MERGE
	MERGC

FILES: NDI - Source edit-formatted output file used as input file for data and logic preprocessor segments

ROUTINE NAME: PAGEH

DESCRIPTION: This routine ejects the page and writes the page heading on all pages generated by the preprocessor.

CALLING SEQUENCE: CALL PAGEH (N)

N = 0 Do not write card column designator line
N = 1 Write card column designator line

REFERENCED BY:

SEGMENT	ROUTINE	SEGMENT	ROUTINE
TRASYS	INRDD	SRFCRD	SRFCS1
	SERROR		SRFCBC
START	HEADCD	BCSRD	BCSRD
INITAL	OPTNRD	DCMNRD	DCMNRD
MCOLL	MCOLL	FRMFRD	FRMFRD
SEDIT	SEDIT	SHDWRD	SHDWRD
		FLUXRD	FLUXRD
		CRSPRD	CRSPRD
	PTPHSF	LOGIC1	LOGIC1
	MERGC	LOGIC2	LOGIC2
GNEDO	PTHSTY	LOGIC3	LOGIC3
DATARD	DATARD	RAPUP	RAPUP
QUANRD	QUANRD		
ARRYRD	ARRYRD		
SKIRD	SKIRD		
	PTCKS1		

FILES: NOUT - System output file

ROUTINE NAME: PARAB

DESCRIPTION: This routine converts point input for paraboloids to program-compatible surface description parameters and sets up Euler angles and a position vector to transform the ICS, BCS, or CCS into the SCS of the paraboloid.

CALLING SEQUENCE: CALL PARAB

REFERENCED BY:

SEGMENT	ROUTINE
SDPSS2	SDTPS2

FILES: NOUT - System output file

ROUTINE NAME: PDUMP (CDC system routine)

DESCRIPTION: This routine dumps the main memory on the system output file.

CALLING SEQUENCE: CALL PDUMP (A, B, C)

A - Starting location to start dumping
B - Last word to be dumped
C - Mode in which to dump the words
0 = Octal dump
1 = Real dump
2 = Integer dump
3 = Octal dump
4 = Octal dump

REFERENCED BY:

SEGMENT	ROUTINE
SDPSS2	SDTPS2
	IMAGES
FRMFRD	FRMFRD
	BLDR
	FINAL
	MERGF
FLUXRD	FLUXRD
	DIBLOR

FILES: NOUT - System output file

ROUTINE NAME: POLYGN

DESCRIPTION: This routine generates N - 2 triangles from point input, where N is the number of points, and sets up Euler angles and a position vector for each triangle generated.

CALLING SEQUENCE: CALL POLYGN (ISURF)

ISURF - A counter, from 1 to N-2, indicating which triangle is being generated

REFERENCED BY:

SEGMENT	ROUTINE
SDPSS2	SDTPS2

FILES: NOUT - System output file

ROUTINE NAME: POSIT

DESCRIPTION: This routine transposes a vector in the ICS, BCS, or CCS into the SCS of a reference plane (for imaging purposes), negates the Z component, and transforms it back into the ICS, BCS, or CCS.

CALLING SEQUENCE: CALL POSIT (X, Y, Z, TRAN)

X, Y, Z - Vector components in the ICS, BCS, or CCS

TRAN - A 3x3 matrix of direction cosines to transform a vector from the ICS, BCS, or CCS to the SCS

REFERENCED BY:

SEGMENT	ROUTINE
SDPSS2	IMAGES

ROUTINE NAME: PPTIM (CDC system routine)

DESCRIPTION: This routine will return the accumulated peripheral processor time, in integer seconds, incurred up to the time of the call.

CALLING SEQUENCE: CALL PPTIM (N)

N = Return integer preprocessor time

REFERENCED BY:

SEGMENT	ROUTINE
SDPSS2	SDTPS2
SDPSS2	IMAGES
TRASYS	TRASYS
START	START
DATARD	DATARD
LOGICO	LOGICO
TPGEN	TPGEN
RAPUP	RAPUP

ROUTINE NAME: PRNTCK

DESCRIPTION: This routine outputs the traced node/surface data if the variable ITRC25 is set in the OPTIONS DATA block.

CALLING SEQUENCE: CALL PRNTCK (ITP)

ITP - Flag defining node dump or surface dump

REFERENCED BY:

SEGMENT	ROUTINE
SDPSS2	SDTPS2
	IMAGES

FILES: NOUT - System output file

ROUTINE NAME: PTCHEK

DESCRIPTION: This routine, given an array of points, checks for duplicates, and returns ICHEK as a flag.

CALLING SEQUENCE: CALL PTCHEK (N, IT, JT, X, ICHEK)

```
N     - Number of points to be checked
IT    - Skip this point
JT    - Skip this point
X     - Array of point data
ICHEK - 0 = Points not same
        1 = Points same
```

REFERENCED BY:

SEGMENT	ROUTINE
SDPSS2	BOX POLYGN TRAPZ RECT

ROUTINE NAME: PTCKS1

DESCRIPTION: This routine writes out the surface ICS directory, ICS values, constant-directory and the constant values. This routine is only executed when the surface data pass 1 error trace flag is turned on in the OPTIONS DATA block.

CALLING SEQUENCE: CALL PTCKS1

REFERENCED BY:

SEGMENT	ROUTINE
SKIRD	SKIRD

FILES: NOUT - System output file

ROUTINE NAME: PTDIR

DESCRIPTION: This routine writes the directory record of a source edit-formatted tape to the system output file.

CALLING SEQUENCE: CALL PTDIR (NU, IDIR)

NU - File that contained the director to be printed

IDIR - The array containing the director to be printed

FILES: NOUT - System output file

ROUTINE NAME: PTHSTY

DESCRIPTION: This routine writes the history record of a source edit-formatted tape to the system output file.

CALLING SEQUENCE: CALL PTHSTY (IHS, ITTPFT)

IHS - The array that contains the history record to be printed

ITTPFT - Approximate tape footage used by model being printed

REFERENCED BY:

SEGMENT	ROUTINE
GNEDO	GNEDO

FILES: NOUT - System output file

ROUTINE NAME: PTPHSF

DESCRIPTION: This routine prints and/or punches the NDI source edit-formatted file.

CALLING SEQUENCES: CALL PTPHSF (ISEQ)

ISEQ = 0 No sequencing in Columns 73-80 is wanted on the punched output
ISEQ ≠ 0 Sequencing in Column 73-80 is wanted on the punched output

REFERENCED BY:

SEGMENT	ROUTINE
SEDIT	SEDIT

FILES: NOUT - System output file

ROUTINE NAME: PTSVER

DESCRIPTION: This routine writes the character mark under the bad character or field when an error is encountered. This routine also saves the bad card edit sequence line number so that it can be printed at the end of the preprocessor execution.

CALLING SEQUENCE: PTSVER (IC, IER)

IC - Column to print error character mark
IC = 1 is actual character 7 on the input card.
IER - = 0 Fatal error was encountered.
≠ 0 Caution error was encountered.

REFERENCED BY:

SEGMENT	ROUTINE
TRASYS	SERROR

FILES: NOUT - System output file

ROUTINE NAME: QUANRD

DESCRIPTION: This routine processes the user-input QUANTITIES DATA block.

CALLING SEQUENCE: CALL QUANRD

REFERENCED BY:

SEGMENT	ROUTINE
DATARD	DATARD

FILES: NOUT - System output file
NSCl - Scratch file used to write theuser quantity values. This file is written is pass 1 and read in pass 2
NRIO - Preprocessor and processor random I/O communication file

ROUTINE NAME: QUANSD

DESCRIPTION: This routine writes to the NRIO file the control quantities directory and values when the user does not input a QUANTITIES DATA block.

CALLING SEQUENCE: CALL QUANSD

REFERENCED BY:

SEGMENT	ROUTINE
QUANRD	QUANRD

FILES: NOUT - System output file
NRIO - Preprocessor and processor random I/O communication file

ROUTINE NAME: RAPUP

DESCRIPTION: This routine writes the time and core statistics at the end of the preprocessor output. This routine also terminates the preprocessor either normally or in the case of fatal errors, abnormally.

CALLING SEQUENCE: CALL RAPUP

REFERENCED BY:

SEGMENT	ROUTINE
TRASYS	TRASYS

FILES: NOUT - System output file

ROUTINE NAME: RDPSN

DESCRIPTION: This routine, given the dimension of a surface or node, defines the position vector to the center of the node and the radius of the sphere large enough to enclose it.

CALLING SEQUENCE: CALL RDPSN (VEC, BETA, GAMMA, DB, DG)

VEC(3) - Array containing (X, Y, Z) position to center
BETA, GAMMA - Length along side of node
DB, DG - Distance to center of node/surface

REFERENCED BY:

SEGMENT	ROUTINE
SDPSS2	SDTPS2

ROUTINE NAME: RDPSS

DESCRIPTION: This routine computes the radius and corresponding position vector used to encompass the surface and locate the center.

CALLING SEQUENCE: CALL RDPSS (VEC)

VEC - Array of position vectors

REFERENCED BY:

SEGMENT	ROUTINE
SDPSS2	SDTPS2

ROUTINE NAME: READMS

DESCRIPTION: This routine reads a logical record from a random I/O mass storage file.

CALLING SEQUENCE: CALL READMS (U, FWA, N, K)

U - Unit designator.
FWA - Address in central memory of first word of record
N - Number of central memory words in the record to be transferred
K - Number index of record or name index of record to be read. (In TRASYS, K = 1 always)

REFERENCED BY:

SEGMENT	ROUTINE
SRFCRD	DUPSRF
SDPSS2	IMAGES
BCSRD	BCSRD
SHDWRD	SFWPL
LGOIC1	LOGIC1

ROUTINE NAME: READVF

DESCRIPTION: This routine reads in header form factor data and loads the various arrays generating all requests for data.

CALLING SEQUENCE: CALL READVF (NODIN1, JEOF, INDEX, NN2, NN, IFRST, NMAX)

NODIN1 - Array of packed node numbers and values
JEOF - = 3HEND End of data, ≠ 3HEND Not end of data
INDEX - Number of values stored in NODIN1
NN2 - Number of nodes * 2
NN - Number of nodes
IFRST - Flag indicating first time called
NMAX - Maximum number of word in data block

REFERENCED BY:

SEGMENT	ROUTINE
FRMFRD	BLDR

FILES: NOUT - System output file

ROUTINE NAME: RECT

DESCRIPTION: This routine converts point input for rectangles to program-compatible surface description parameters and sets up Euler angles and a position vector to transform the ICS, BCS, or CCS into the SCS of the rectangle.

CALLING SEQUENCE: CALL RECT

REFERENCED BY:

SEGMENT	ROUTINE
SDPSS2	SDTPS2

FILES: NOUT - System output file

ROUTINE NAME: REFCD

DESCRIPTION: This routine sets up surface description information for reference planes and writes it on the random access file.

CALLING SEQUENCE: CALL REFCD (ISSX)

ISSX - The index of the starting location where surface description data for the reference plane is to be loaded in blank common

REFERENCED BY:

SEGMENT	ROUTINE
SRFCRD	SRFCS1

FILES: NRIO - Random access file

ROUTINE NAME: RETURNS (CDC system function)

DESCRIPTION: This routine releases a local file from a job.

CALLING SEQUENCE: CALL RETURNS (N)

N = Name of file to be released

REFERENCED BY:

SEGMENT	ROUTINE
SRFCRD	SRFCRD

ROUTINE NAME: SCHECK

DESCRIPTION: This routine checks the validity of user-input surface description parameters and sets the default values.

CALLING SEQUENCE: CALL SCHECK (ISSX, IERR)

ISSX - The index of the starting location of surface description data in blank common

IERR - Counter for the number of fatal errors found in the user-input surface descriptions

REFERENCED BY:

SEGMENT	ROUTINE
SRFCRD	SRFCS1

FILES: NOUT - System output file

ROUTINE NAME: SDPSS2

DESCRIPTION: This routine sets up blank common indexes for use in processing the surface description data in pass 2.

CALLING SEQUENCE: CALL SDPSS2

REFERENCED BY:

SEGMENT	ROUTINE
DATARD	DATARD

FILES: NOUT - System output file

ROUTINE NAME: SDTPS2

DESCRIPTION: This routine reads user-input surface description data from a sequential scratch file that was written in surface data pass 1, converts the data to program compatible surface description parameters, and writes the data on the random access file.

CALLING SEQUENCE: CALL SDTPS2 (INDEXS, INDEXN, ISAVE)

INDEXS - Array of BCS names and corresponding random access record numbers for surfaces
INDEXN - Array of random access record numbers for nodes
ISAVE - Array of surface numbers and corresponding random access record numbers

REFERENCED BY:

SEGMENT	ROUTINE
SDPSS2	SDPSS2

FILES: NOUT - System output file
NRIO - Random access file
NSCR1 - Scratch file

ROUTINE NAME: SECOND

DESCRIPTION: This routine returns the central-processor time from the start of job, in seconds, in floating-point format, accurate to one thousandth of a second

CALLING SEQUENCE: CALL SECOND (T)

T = Variable that central processor seconds will be returned to

REFERENCED BY:

SEGMENT	ROUTINE
TRASYS	TRASYS
START	START
DATARD	DATARD
LOGICO	LOGICO
TPGEN	TPGEN
RAPUP	RAPUP

ROUTINE NAME: SEDIT

DESCRIPTION: This routine and the routines that it calls perform the preprocessor source edit function of the TRASY program.

CALLING SEQUENCE: CALL SEDIT

REFERENCED BY:

SEGMENT	ROUTINE
START	START

FILES: NIN - System input file
NOUT - System output file

ROUTINE NAME: SERROR

DESCRIPTION: This routine is called when a caution or error condition results when preprocessing the user's input. This routine and the routines that it calls store the error accounting information and account for proper line-page format on printed error messages.

CALLING SEQUENCE: CALL SERROR (NTYP, NARRW, ILINE, NCOL, KER)

NTYP = 0 Caution message is to be printed
= 1 Error message is to be printed
NARRW - Column to print error character
ILINE - Number of error message lines to be printed
NCOL = 0 No output column number on page heading
= 1 Print output column numbers on page heading
KER - The returned caution or error number

REFERENCED BY:

SEGMENT	ROUTINE	SEGMENT	ROUTINE
TRASYS	HCARD	SDPSS2	BOX
	CDPRC1		CALB
	CDPRC2		CALG
	FDPRC		CHEC
START	HEADCD		CONE
INITAL	OPTNRD		CYLNDR
SEDIT	SEDIT		DISC
			IMAGES
			PARAB
	EPTAPE		POLYGN
	ASKCRD		TRAFZ
	INRDE		RECT
	MERGC		SPHERE
DATARD	DATARD	BCSRD	BCSRD
	STORDT		
QUANRD	QUANRD		BCSP1
ARRYRD	ARRYRD		
			BCSP2
		FRMFRD	FRMFRD

REFERENCED BY: (continued)

SEGMENT	ROUTINE	SEGMENT	ROUTINE
SKIRD	SKIRD		FINAL
			READVF
	KP1		
		SHDWRD	SHDWRD
	IP1		
			SFTBRD
	IP2		
	KP2		
SRFCRD	SRFCRD	FLUXRD	FLUXRD
	SRFCS1		
			DIBLDR
	SRFCBC	CRSPRD	CRSPRD
	CDPRC3		
	DUPSRF	LOGIC0	LOGIC0
	SCHECK	LOGIC1	LOGIC1
			LP1
	SRFCDM		ORBGEN
		LOGIC2	LOGIC2
		LOGIC3	LOGIC3

FILES: NOUT - System output file.

ROUTINE NAME: SFCIO

DESCRIPTION: This routine copies the unused or requested SAVE models on the NSHADI file to the NSHADO file.

CALLING SEQUENCE: CALL SFCIO (ISHAD2, NSF)

ISHAD2 = Shadow factor request directory
NSF = Number of shadow factor models on NSHADI file.

REFERENCED BY:

SEGMENT	ROUTINE
SHDWRD	SHDWRD

FILES: NSHADI - Shadow factor use-input file
NSHADO - Shadow factor user-output file
NOUT - System output file

ROUTINE NAME: SFRSI

DESCRIPTION: This routine reads in the requested shadow factor data from the NSHADI file and writes the data to the NPLSR file.

CALLING SEQUENCE: CALL SFRSI (NDE1, NDE2, NDE3, NDE4, IECC, IPCC, NODEA, NODET)

NDE1 - Last word of the IX array that contains the node array directory input by the user

NDE2 - Last word of the IX array that contains the node array directory input from the NSHADI file

NDE3 - Last word of the IX array that contains the shadow factor request directory

NDE4 - Last word of the IX array that contains the scratch random I/O file index array (used on CDC systems only)

IECC - Output array from this routine that will contain the unpacked cone-clock values

IPCC - Array containing the cone-clock values in packed form read from the NSHADI file in this routine

NODEA - Number of nodes in the node array input from user input data

NODET - Number of nodes in the node array input from the NSHADI file

KEY VARIABLES: IX - Preprocessor blank common dynamic storage array

REFERENCED BY:

SEGMENT	ROUTINE
SHDWRD	SHDWRD

FILES: NOUT - System output file
NSHADI - Shadow factor user input file

ROUTINE NAME: SFTBRD

DESCRIPTION: This routine reads and processes the TABLE and RECØMP shadow factor data block input cards for a single node and writes the processed data to the NRIOS file.

CALLING SEQUENCE: CALL SFTBRD (NDE1, NDS3, IECC)

NDE1 - Last word of the IX array that contains the node array directory input by the user

NDS3 - Starting address of the shadow factor request directory

IECC - Scratch array to contain the cone-clock value for writeout to the NRIOS file

REFERENCED BY:	SEGMENT	ROUTINE
	SHDWRD	SHDWRD

FILES: NOUT - System output file
NRIOS - Scratch random I/O file that the user-input shadow factor data are written to

ROUTINE NAME: SFUNPK

DESCRIPTION: This routine unpacks the 9 cone and 19 clock values from a 19-word array and generates the expanded 9,19 cone-clock array.

CALLING SEQUENCE: CALL SFUNPK (IPCC, IECC)

IPCC - Array containing information to be unpacked
IECC - Array to contain the unpacked information

REFERENCED BY:	SEGMENT	ROUTINE
	SHDWRD	SHDWRD SPRSI

FILES: NOUT - System output file
NSHADI - Shadow factor user input file

ROUTINE NAME: SFWPL

DESCRIPTION: This routine writes the NPLSR file from the shadow factor data that reside on the NRIOS file.

CALLING SEQUENCE: CALL SFWPL (NDE1, NDS3, IECC, KECC)

NDE1 - Last word of the IX array that contains the node array directory input by the user This array is also the node output directory

NDS3 - Starting word of the IX array that contains the shadow factor request directory

IECC - Scratch array to read in and write out of

KECC - Length of the records to be read off the NRIOS file

REFERENCED BY:

SEGMENT	ROUTINE
SHDWRD	SHDWRD

FILES: NOUT - System output file

NRIOS - Scratch random I/O file

NPLSR - File used to transmit the shadow factor data from the preprocessor to the processor

ROUTINE NAME: SHDWRD

DESCRIPTION: This routine and the routines that it calls read in and process the SHADOW DATA user's input block, combine it with the shadow factor data residing on a shadow factor input tape, and output the data on a file to be processed in the processor phase.

CALLING SEQUENCE: CALL SHDWRD

REFERENCED BY:

SEGMENT	ROUTINE
DATARD	DATARD

FILES: NOUT - System output file

NPLSR - File used to transmit the shadow factor data from the preprocessor to the processor

NSHADI- The user-input shadow factor input tape

NRIOS - Scratch random I/O file

ROUTINE NAME: SKFILE

DESCRIPTION: This routine skips to end positions after an end-of-file mark on a specified mass storage unit.

CALLING SEQUENCE: CALL SKFILE (U, N)

U - Unit name or number that is to have the file skipped
N - The number of files to skip

REFERENCED BY:

SEGMENT	ROUTINE
SEDIT	EPTAPE
GNEDO	GNEDO
DATARD	STORDT
SHDWRD	SHDWRD
	SFCIO

ROUTINE NAME: SKIRD

DESCRIPTION: This routine, along with the routines that it calls, reads in and processes the I and K cards that the user inputs in the SURFACE DATA input block.

CALLING SEQUENCE: CALL SKIRD

REFERENCED BY:

SEGMENT	ROUTINE
DATARD	DATARD

FILES: NOUT - System output file

ROUTINE NAME: SORTD

DESCRIPTION: This routine numerically sorts a doublet array. The original order is not preserved on equal comparisons.

CALLING SEQUENCE: CALL SORTD (IA, NA)

IA - The array to be sorted. The sorted array is also returned in this array

NA - The length of the array to be sorted

REFERENCED BY:

SEGMENT	ROUTINE
INITAL	OPTNRD
QUANRD	QUANRD
ARRYRD	ARRYRD
SKIRD	SKIRD
SRFCRD	SRFCS1

REFERENCED BY: (continued)

SEGMENT	ROUTINE
BCSRD	BCSRD
FRMFRD	FRMFRD
SHDWRD	SHDWRD
	SFRSI
FLUXRD	FLUXRD
LØGIC1	LOGIC1
	LP1

ROUTINE NAME: SORTDB

DESCRIPTION: This routine numerically sorts a doublet array. The original order is preserved on equal comparisons.

CALLING SEQUENCE: CALL SORTDB (IA, IB, NN)

IA - The array to be sorted. The sorted array is also returned in the array

IB - A scratch array equal in length to the IA array

NN - The length of the array to be sorted

REFERENCED BY:

SEGMENT	ROUTINE
FRMFRD	BLDR

ROUTINE NAME: SORTS

DESCRIPTION: This routine numerically sorts an array. The original order is not preserved on equal comparisons.

CALLING SEQUENCE: CALL SORTS (A, JJ)

A - The array to be sorted. The sorted array is also returned in this array

JJ - Length of the array to be sorted

REFERENCED BY:

SEGMENT	ROUTINE
BCSRD	BCSRD

ROUTINE NAME: SPHERE

DESCRIPTION: Converts point input for spheres to program-compatible surface description parameters and sets up Euler angles and a position vector to transform the ICS, BCS, or CCS into the SCS of the sphere.

CALLING SEQUENCE: CALL SPHERE

REFERENCED BY:

SEGMENT	ROUTINE
SDPSS2	SDTPS2

FILES: NOUT - System output file

ROUTINE NAME: SRFCBC

DESCRIPTION: This routine processes the BCS user-input cards input in the BCS DATA block.

CALLING SEQUENCE: CALL SRFCBC

REFERENCED BY:

SEGMENT	ROUTINE
SRFCRD	SRFCRD

FILES: NOUT - System output file

ROUTINE NAME: SRFCDM

DESCRIPTION: This routine processes the DIMENSION variable and its associated data values that the user inputs as part of the surface description input.

CALLING SEQUENCE: CALL SRFCDM (KTYPE, IDM, JDM)

KTYPE - The type of surface being processed:

1 = Rectangle
2 = Disk
3 = Trapezoid
4 = Cylinder
5 = Cone
6 = Sphere
7 = Paraboloid
8 = 5-Sided box
9 = 6-Sided box
10 = Polygon

IDM - Length of the JDM array
JDM - Array containing the data to be processed

REFERENCED BY:

SEGMENT	ROUTINE
SRFCRD	SRFCS1

FILES: NOUT - System output file

ROUTINE NAME: SRFCRD

DESCRIPTION: This routine and the routines that it calls read in and process the surface description data the user inputs in the SURFACE DATA block.

CALLING SEQUENCE: CALL SRFCRD

REFERENCED BY:

SEGMENT	ROUTINE
DATARD	DATARD

FILES: NOUT - System output file
NRIOS - Scratch random I/O file

ROUTINE NAME: SRFCS1

DESCRIPTION: This routine reads in the S, R, N, and D cards of the user-input SURFACE DATA block, decodes these cards, and writes the surface information to file NRIOS for input to the surface data pass 2 processing.

CALLING SEQUENCE: CALL SRFCS1

REFERENCED BY:

SEGMENT	ROUTINE
SRFCRD	SRFCRD

FILES: NOUT - System output file
NRIOS - Temporary random I/O scratch file for passing the surface description information to the surface data pass 2 processor

ROUTINE NAME: START

DESCRIPTION: This routine calls routines that initialize the label commons, write the TRASYS preprocessor banner page on the system output file, read in and process the user-input OPTION DATA block, and perform the model collecting and/or source editing functions.

CALLING SEQUENCE: CALL START

REFERENCED BY:

SEGMENT	ROUTINE
TRASYS	TRASYS

ROUTINE NAME: STORDT

DESCRIPTION: This routine writes all header records to internal data files and keeps count of the internal files.

CALLING SEQUENCE: CALL STORDT (NUNIT, ISTEP, LABEL1, LABEL2)

NUNIT - Unit to contain data
ISTEP - Step number
LABEL1 - Identifies 1
LABEL2 - Identifies 2

REFERENCED BY:

SEGMENT	ROUTINE
SDPSS2	AUTOCM
FRMFRD	FINAL
SHDWRD	SHDWRD
FLUXRD	DIBLDR
CRSPRD	CRSPRD

ROUTINE NAME: STUFDT

DESCRIPTION: This routine stores all data directly applicable to each node/surface that requires no conversion determined in surface data pass

CALLING SEQUENCE: CALL STUFDT

REFERENCED BY:

SEGMENT	ROUTINE
SDPSS2	SDTPS2

ROUTINE NAME: TIME (CDC system routine)

DESCRIPTION: This routine will return the current clock time in Hollerith code of the format...

HH.MM.SS (CDC)   HHMMSS (UNIVAC)

CALLING SEQUENCE: CALL TIME (TME)

TME - The returned time variable

REFERENCED BY:

SEGMENT	ROUTINE
TRASYS	PAGEH

ROUTINE NAME: <u>TPGEN</u>

DESCRIPTION: This routine writes the variable record pointers for the random I/O file and the TRASYS processor logical file designators to the NSQNTL file.

CALLING SEQUENCE: CALL TPGEN

REFERENCED BY:

SEGMENT	ROUTINE
TRASYS	TRASYS

FILES: NSQNTL - The preprocessor and processor communication file

ROUTINE NAME: <u>TRAPZ</u>

DESCRIPTION: This routine converts point input for trapezoids to program-compatible surface description parameters and sets up Euler angles and a position vector to transform the ICS, BCS, or CCS into the SCS of the trapezoid.

CALLING SEQUENCE: CALL TRAPZ (ISCS)

ISCS - Flag to indicate if points were input in the surface coordinate system

REFERENCED BY:

SEGMENT	ROUTINE
SDPSS2	SDTPS2

FILES: NOUT - System output file

ROUTINE NAME: <u>TRASYS</u>

DESCRIPTION: This routine is the major segment driver for the TRASYS preprocessor. It calls five subsegments; and initialization segment, data read segment, logic read setment, communication file initialization segment, and the wrapup segment.

CALLING SEQUENCE: None

REFERENCED BY: None (this is the main preprocessor segment.)

ROUTINE NAME: TRNGLE

DESCRIPTION: This is an entry point in subroutine TRAPZ that converts point input for triangles to program-compatible surface description parameters and sets up Euler angles and a position vector to transform the ICS, BCS, or CCS into the SCS of the triangle.

CALLING SEQUENCE: CALL TRNGLE (ISCS)

ISCS - Flag to indicate if points were input in the surface coordinate system

REFERENCED BY:

SEGMENT	ROUTINES
SDPSS2	IMAGES POLYGN

FILES: NOUT - System output file

ROUTINE NAME: TRS3

DESCRIPTION: This routine transforms a vector in an SCS to a vector in the ICS, BCS, or CCS.

CALLING SEQUENCE: CALL TRS3 (X, Y, Z, A, B, C, RX, RY, RZ, TRAN)

KEY VARIABLES:

X, Y, Z - Components of vector in ICS, BCS, or CCS
A, B, C - Components of vector in SCS
RX, RY, RZ - Position vector of SCS origin in ICS, BCS, or CCS
TRAN - 3x3 transformation matrix

REFERENCED BY:

SEGMENT	ROUTINES
SDPSS2	BOX IMAGES SDTPS2

ROUTINE NAME: WCMMN

DESCRIPTION: This routine writes to file NCMPL a Fortran-labeled common statement based on the information in the argument list.

CALLING SEQUENCE: CALL WCMMN (NAME, LNM, N, NT)

NAME - Common name
LNM - Array containing a list of names to be the variables within the common being written
N - Length of the LNM array
NT - Type of common to write
= 0 Single-value variable name
= 1 Single-dimension (vector) names. The LNM under this option is in format...

```
Word  1 NAME
      2 Dimension
      3 NAME
        (etc)
```

REFERENCED BY:

SEGMENT	ROUTINE
LOGICO	WCOMO

FILES: NCMPL - The file that the generated Fortran cards are written to

ROUTINE NAME: WCOMO

DESCRIPTION: This routine writes the TRASYS main-program segment commons to the NCMPL file.

CALLING SEQUENCE: CALL WCOMO

REFERENCED BY:

SEGMENT	ROUTINE
LOGICO	WPRGO WRITNP
LOGIC2	LOGIC2
LOGIC3	LOGIC3

FILES: NCMPL - The file that the generated Fortran cards are written to

ROUTINE NAME: WCOM

DESCRIPTION: This routine is a collection of entry points that write the Fortran common statements of the processor subsegments.

CALLING SEQUENCE: WCOM is not called, only the entry points are called.

ENTRY POINTS:

CALL CM30	- FFPROG segment
CALL CM40	- SFPROG segment
CALL CM50	- NPPROG segment
CALL CM60	- OPPROG segment
CALL CM70	- DIPROG segment
CALL CM80	- GBPROG segment
CALL CM90	- RKPROG segment
CALL CM100	- AQPROG segment
CALL CM110	- QOPROG segment
CALL CM120	- RBPROG segment
CALL CM140	- RCPROG segment
CALL CM150	- DRPROG segment

REFERENCES: None

ROUTINE NAME: WGOTO

DESCRIPTION: This routine writes to the file NCMPL a Fortran-computed GO TO statement based on the information in the argument list.

CALLING SEQUENCE: CALL WGOTO (NSS, NIS, NSN, NAME)

NSS - Starting statement number
NIS - Number to increment the statement number
NSN - Number of statement numbers wanted
NAME - Name of the variable to place on the computed GO TO statement

REFERENCED BY:

STATEMENT	ROUTINE
LOGICO	WRITNP
LOGIC2	LOGIC2

FILES: NCMPL - The file that the generated processor Fortran cards are written to

REFERENCES: None

ROUTINE NAME: WPRGO

DESCRIPTION: This routine writes the processor main-program segment to the NCMP file.

CALLING SEQUENCE: CALL WPRGO

REFERENCED BY:

SEGMENT	ROUTINE
LOGICO	WRITNP
LOGIC2	LOGIC2

FILES: NCMPL - The file that the generated processor Fortran cards are written to

ROUTINE NAME: WPRG2

DESCRIPTION: This routine name is an entry point into the routine WPROG. When this entry point name is called, the Fortran processor subsegment driver RDPROG is written to the file NCMPL.

CALLING SEQUENCE: CALL WPRG2

REFERENCED BY:

SEGMENT	ROUTINE
LOGICO	WRITNP
LOGIC3	LOGIC3

FILES: NCMPL - The file that the generated processor Fortran cards are written to

ROUTINE NAME: WPRG3

DESCRIPTION: This routine name is an entry point into the routine WPROG. When this entry point name is called, the Fortran processor subsegment driver FFPROG is written to the file NCMPL.

CALLING SEQUENCE: CALL WPRG3

REFERENCED BY:

SEGMENT	ROUTINE
LOGIC3	LOGIC3

FILES: NCMPL - The file that the generated processor Fortran cards are written to

ROUTINE NAME: WPRG4

DESCRIPTION: This routine name is an entry point into the routine WPROG. When this entry point name is called, the Fortran processor subsegment driver SFPROG is written to the file NCMPL.

CALLING SEQUENCE: CALL WPRG4

REFERENCED BY:

SEGMENT	ROUTINE
LOGIC3	LOGIC3

FILES: NCMPL - The file that the generated processor Fortran cards are written to

ROUTINE NAME: WPRG5

DESCRIPTION: This routine name is an entry point into the routine WPROG. When this entry point name is called, the Fortran processor subsegment driver NPPROG is written to the file NCMPL.

CALLING SEQUENCE: CALL WPRG4

REFERENCED BY:

SEGMENT	ROUTINE
LOGIC0	WRITNP
LOGIC3	LOGIC3

FILES: NCMPL - The file that the generated processor Fortran cards are written to

ROUTINE NAME: WPRG6

DESCRIPTION: This routine name is an entry point into the routine WPROG. When the entry point name is called, the Fortran processor subsegment driver OPPROG is written to the file NCMPL.

CALLING SEQUENCE: CALL WPRG6

REFERENCED BY:

SEGMENT	ROUTINE
LOGIC3	LOGIC3

FILES: NCMPL - The file that the generated processor Fortran cards are written to

ROUTINE NAME: WPRG7

DESCRIPTION: This routine name is an entry point into the routine WPROG. When this entry point name is called, the Fortran processor subsegment driver DIPROG is written to the NCMPL file.

CALLING SEQUENCE: CALL WPRG7

REFERENCED BY:

SEGMENT	ROUTINE
LOGIC3	LOGIC3

FILES: NCMPL - The file that the generated processor Fortran cards are written to

ROUTINE NAME: WPRG8

DESCRIPTION: This routine name is an entry point into the routine WPROG. When this entry point name is called, the Fortran processor subsegment driver GBPROG is written to the NCMPL file.

CALLING SEQUENCE: CALL WPRG8

REFERENCED BY:

SEGMENT	ROUTINE
LOGIC3	LOGIC3

FILES: NCMPL - The file that the generated processor Fortran cards are written to

ROUTINE NAME: WPRG9

DESCRIPTION: This routine name is an entry point into the routine WPROG. When this entry point name is called, the Fortran processor subsegment driver RKPROG is written to the NCMPL file.

CALLING SEQUENCE: CALL WPRG9

REFERENCED BY:

SEGMENT	ROUTINE
LOGIC3	LOGIC3

FILES: NCMPL - The file that the generated processor Fortran cards are written to

ROUTINE NAME: WPRG10

DESCRIPTION: This routine name is an entry point into the routine WPROG. When this entry point name is called, the Fortran processor subsegment driver AQPROG is written to the NCMPL file.

CALLING SEQUENCE: CALL WPRG10

REFERENCED BY:

SEGMENT	ROUTINE
LOGIC3	LOGIC3

FILES: NCMPL - The file that the generated processor Fortran cards are written to

ROUTINE NAME: WPRG11

DESCRIPTION: This routine name is an entry point into the routine WPROG. When this entry point name is called, the Fortran processor subsegment driver QOPROG is written to the NCMPL file.

CALLING SEQUENCE: CALL WPRG11

REFERENCED BY:

SEGMENT	ROUTINE
LOGIC3	LOGIC3

FILES: NCMPL - The file that the generated processor Fortran cards are written to

ROUTINE NAME: WPRG12

DESCRIPTION: This routine name is an entry point into the routine WPROG. When this entry point name is called, the Fortran processor subsegment driver RBPROG is written to the NCMPL file.

CALLING SEQUENCE: CALL WPRG12

REFERENCED BY:

SEGMENT	ROUTINE
LOGIC3	LOGIC3

FILES: NCMPL - The file that the generated processor Fortran cards are written to

ROUTINE NAME: WPRG13

DESCRIPTION: The routine name is an entry point into the routine WPROG. When this entry point name is called, the Fortran processor subsegment driver PLPROG is written to the NCMPL file.

CALLING SEQUENCE: CALL WPRG13

REFERENCED BY:

SEGMENT	ROUTINE
LOGIC3	LOGIC3

FILES: NCMPL - The file that the generated processor Fortran cards are written to

ROUTINE NAME: WPRG14

DESCRIPTION: This routine name is an entry point into the routine WPROG. When this entry point name is called, the Fortran processor subsegment driver RCPROG is written to the NCMPL file.

CALLING SEQUENCE: CALL WPRG14

REFERENCED BY:

SEGMENT	ROUTINE
LOGIC3	LOGIC3

FILES: NCMPL - The file that the generated processor Fortran cards are written to

ROUTINE NAME: WPRG15

DESCRIPTION: This routine name is an entry point into the routine WPROG. When this entry point name is called, the Fortran processor subsegment driver DRPROG is written to the NCMPL file.

CALLING SEQUENCE: CALL WPRG15

REFERENCED BY:

SEGMENT	ROUTINE
LOGIC3	LOGIC3

FILES: NCMPL - The file that the generated processor Fortran cards are written to

ROUTINE NAME: WPROG

DESCRIPTION: This routine is a collection of entry points that writes the Fortran main routines of the processor subsegments.

CALLING SEQUENCES: WPROG is not called, only the entry points are called

ENTRY POINTS:
CALL WPRG2 - RDPROG segment
CALL WPRG3 - FFPROG segment
CALL WPRG4 - SFPROG segment
CALL WPRG5 - NPPROG segment
CALL WPRG6 - OPPROG segment
CALL WPRG7 - DIPROG segment
CALL WPRG8 - GBPROG segment
CALL WPRG9 - RKPROG segment
CALL WPRG10 - AQPROG segment
CALL WPRG11 - QOPROG segment
CALL WPRG12 - RBPROG segment
CALL WPRG13 - PLPROG segment
CALL WPRG14 - RCPROG segment
CALL WPRG15 - DRPROG segment

ROUTINE NAME: WRITNP

DESCRIPTION: This routine writes the processor ODPROG subsegment, which overrides the user-input LOGIC DATA block when an error is encountered in the user input. This generated Fortran operation data block causes the node plotter to plot each of the BCS-defined data blocks.

CALLING SEQUENCE: CALL WRITNP (NBCS, NBCSA)

NBCS - Number of BCS-defined surface systems to be plotted

NBCSA - The array that contains the names of the BCS surface systems

REFERENCED BY:

SEGMENT	ROUTINE
LOGICO	LOGICO

FILES: NOUT - System output file

NCMPL - The file that the generated processor Fortran cards are written to

ROUTINE NAME: WSCOPE (CDC only)

DESCRIPTION: This routine displays a 6-word message, with the last word zeroed, at the computer operator's console. The only information passed to this routine is program status information.

CALLING SEQUENCE: CALL WSCOPE (MSG)

MSG - Message to be written

REFERENCED BY:

SEGMENT	ROUTINE
TRASYS	TRASYS
START	START
DATARD	DATARD
LOGICO	LOGICO
TPGEN	TPGEN

C. FILE DEFINITIONS - PREPROCESSOR

FILE DEFINITIONS - PREPROCESSOR

C. FILE DEFINITIONS - PREPROCESSOR

FILE NAME: CMERG

PROGRAM VARIABLE NAME: NCMG

UNIT REFERENCE (UNIVAC/JSC): 12

PURPOSE: This file is the user's card image merge file.

SEGMENT REFERENCE: SEDIT (READ)

FILE NAME: CMPL

PROGRAM VARIABLE NAME: NCMPL

UNIT REFERENCE (UNIVAC/JSC): 20

PURPOSE: This is a compile file that contains the processor FORTRAN routines generated by the preprocessor.

SEGMENT REFERENCES: LOGIC0 (WRITE)
LOGIC2 (WRITE)
LOGIC3 (WRITE)

FILE NAME: DATAI

PROGRAM VARIABLE NAME: NDI

UNIT REFERENCE (UNIVAC/JSC): 4

PURPOSE: This file is generated in the SEDIT segment from the INPUT, EDITI, CMERG, and EMERG files. It contains the users input source data, which are read as the input data file in all other segments of the preprocessor.

SEGMENT REFERENCES: SEDIT (WRITE)
GNEDO (READ)
QWANRD (READ)
ARRYRD (READ)
SKIRD (READ)
SRFCRD (READ)
BCSRD (READ)
DCMNRD (READ)
FRMFRD (READ)
SHDWRD (READ)
FLUXRD (READ)
ORSPRD (READ)
LOGIC1 (READ)
LOGIC3 (READ)

FILE NAME: DIR

PROGRAM VARIABLE NAME: NDIR

UNIT REFERENCE (UNIVAC/JSC): 22

PURPOSE: This is the flux data restart file, which contains the flux data request matrix that is generated by the preprocessor and communicated to the processor.

SEGMENT REFERENCES: FLUXRD (WRITE)

FILE NAME: EDITI

PROGRAM VARIABLE NAME: NEDI

UNIT REFERENCE (UNIVAC/JSC): 10

PURPOSE: This file contains the user's source edit input tape.

SEGMENT REFERENCES: SEDIT (READ)
GNEDO (READ)

FILE NAME: EDITO

PROGRAM VARIABLE NAME: NEDO

UNIT REFERENCE (UNIVAC/JSC): 11

PURPOSE: This file is the user's source edit output tape.

SEGMENT REFERENCES: GNEDO (WRITE)

FILE NAME: EMERG

PROGRAM VARIABLE NAME: NEMG

UNIT REFERENCE (UNIVAC/JSC): 13

PURPOSE: This file is the user's edit input merge file.

SEGMENT REFERENCES: MCOLL (WRITE)
SEDIT (READ)

FILE NAME: FFR

PROGRAM VARIABLE NAME: NFFR

UNIT REFERENCE (UNIVAC/JSC): 21

PURPOSE: This is the form factor restart file that contains the form factor request matrix generated by the preprocessor and communicated to the processor.

SEGMENT REFERENCES: FRMFRD (WRITE)

FILE NAME: GBIRR

PROGRAM VARIABLE NAME: NGBIRR

UNIT REFERENCE (UNIVAC/JSC): 23

PURPOSE: This file contains the correspondence data that were processed in the correspondence data read segment in the preprocessor. These data are communicated to the processor through this file.

SEGMENT REFERENCES: CRSPRD (WRITE)

FILE NAME: GBSOR

PROGRAM VARIABLE NAME: NGBSOR

UNIT REFERENCE (UNIVAC/JSC): 24

PURPOSE: This file is the gray-body solar restart file, which is not used at present.

SEGMENT REFERENCES: None

FILE NAME: INPUT

PROGRAM VARIABLE NAME: NIN

UNIT REFERENCE (UNIVAC/JSC): 5

PURPOSE: This file is the system input file, usually the card reader.

SEGMENT REFERENCES: INITAL (READ)
MCOLL (READ)
SEDIT (READ)

FILE NAME: OUTPUT

PROGRAM VARIABLE NAME: NOUT

UNIT REFERENCE (UNIVAC/JSC): 6

PURPOSE: This file is the system output file, usually the line printers.

SEGMENT REFERENCES: All (WRITE)

FILE NAME: PLSR

PROGRAM VARIABLE NAME: NPLSR

UNIT REFERENCE (UNIVAC/JSC): 25

PURPOSE: This file contains the restart shadow factors that are generated by the preprocessor and passed to the processor.

SEGMENT REFERENCES: SHDWRD (WRITE)

FILE NAME: PUNCH

PROGRAM VARIABLE NAME: NPNCH

UNIT REFERENCE (UNIVAC/JSC): 7

PURPOSE: This file is the system punch file.

SEGMENT REFERENCES: SEDITI (WRITE)

FILE NAME: TAPE1

PROGRAM VARIABLE NAME: NSC1

UNIT REFERENCE (UNIVAC/JSC): 1

PURPOSE: This file is scratch file 1, which is used as temporary storage for intermediate data generated within the preprocessor segments. It is also used to communicate data between segments.

SEGMENT REFERENCES: QUANRD (WRITE & READ)
ARRYRD (WRITE & READ)
SKIRD (WRITE & READ)
FRMFRD (WRITE & READ)
LOGIC1 (WRITE)
LOGIC2 (READ)

FILE NAME: TAPE2

PROGRAM VARIABLE NAME: NSC2

UNIT REFERENCE (UNIVAC/JSC): 2

PURPOSE: This is scratch file 2, which is used as temporary storage for intermediate data generated within the preprocessor segments. Is is also used to communicate data between segment.

SEGMENT REFERENCES: QUANRD (WRITE & READ)
ARRYRD (WRITE & READ)
FRMFRD (WRITE & READ)

FILE NAME: TAPE3

PROGRAM VARIABLE NAME: NSC3

UNIT REFERENCE (UNIVAC/JSC): 3

PURPOSE: This is scratch file 3, which is used as temporary storage for intermediate data generated within the preprocessor segments. It is also used to communicate data between segments.

SEGMENT REFERENCES: FRMFRD (WRITE & READ)

FILE NAME: RIO

PROGRAM VARIABLE NAME: NRIO

UNIT REFERENCE (UNIVAC/JSC): 8

PURPOSE: This is the main working random I/O file used in communicating data from one segment to another within the preprocessor, and passing array data, quantities data, and surface data to the processor.

SEGMENT REFERENCES: INITAL (WRITE)   SDPSS2 (WRITE)
QUANRD (WRITE)   BCSRD (WRITE)
ARRYRD (WRITE)   LOGIC2 (WRITE & READ)

FILE NAME: RIOS

PROGRAM VARIABLE NAME: NRIOS

UNIT REFERENCE (UNIVAC/JSC): 9

PURPOSE: This file is the scratch random I/O file. It is used as temporary storage for intermediate data generated within the preprocessor and is also used to communicate data between segments.

SEGMENT REFERENCES: SRFCRD (WRITE)
SDPSS2 (READ)

FILE NAME: RSTRI

PROGRAM VARIABLE NAME: NRSI

UNIT REFERENCE (UNIVAC/JSC): 14

PURPOSE: This file is the user's permanent input restart file. It is not used at present.

SEGMENT REFERENCES: None

FILE NAME: RSTRO

PROGRAM VARIABLE NAME: NRSO

UNIT REFERNECE (UNIVAC/JSC): 15

PURPOSE: This file is the user's permanent output restart file. It is not used at present.

SEGMENT REFERENCES: None

FILE NAME: RTI

PROGRAM VARIABLE NAME: NRTI

UNIT REFERENCE (UNIVAC/JSC): 18

PURPOSE: This file is the user's temporary input restart file. It is not used at present.

SEGMENT REFERENCES: None

FILE NAME: SHADI

PROGRAM VARIABLE NAME: NSHADI

UNIT REFERENCE (UNIVAC/JSC): 27

PURPOSE: This file contains the user-input shadow factor data tape.

SEGMENT REFERENCES: SHDWRD (READ)

FILE NAME: SHADO

PROGRAM VARIABLE NAME: NSHADO

UNIT REFERENCE (UNIVAC/JSC): 28

PURPOSE: This file contains the user-output shadow factor data tape.

SEGMENT REFERENCES: SHDWRD (WRITE)

C-2

FILE NAME: SQNTL

PROGRAM VARIABLE NAME: NSQNTL

UNIT REFERENCE (UNIVAC/JSC): 16

PURPOSE: This is the sequential communication file between the preprocessor and processor.

SEGMENT REFERENCES: TPGEN (WRITE)

FILE NAME: TQR

PROGRAM VARIABLE NAME: NTQR

UNIT REFERENCE (UNIVAC/JSC): 26

PURPOSE: This file is the total "Q" restart file. It is not used at present.

SEGMENT REFERENCES: None

D. VARIABLE DEFINITIONS - PREPROCESSOR

VARIABLE DEFINITIONS - PREPROCESSOR

D. VARIABLE DEFINITIONS - PREPROCESSOR

LABELED COMMON /CARD/

NCDTYP - Variable that contains the first 6 characters of the last input card read

IND - Array variable that contains the 66 characters from Col. 7 thru Col. 72 of the last input card read

NNED - New edit number of the last card read

NOED - Old edit number of the last card read

LMOD - Modification label of the last card read

ID - Number of decoded words in the NDOT and IDOT arrays

NDOT - The array containing the decoded words of the last input card that was decoded

IDOT - The array containing the type of word decoded in the NDOT array

= -(1RI) Integer word

= -(1RF) Floating-point word

= -(1RS) Special character

= + NUMBER Hollerith word character count

JDOT - The array containing the start Col. numbers of the input card data fields

IBE - Last word in the INB buffer array that has been processed

IBT - Last word in the INB buffer array filled with input cards

INB - Buffer array that the 46 cards are read into

IEOF - End of file flag

= 0 No end of file encountered

= 1 End of file has been encountered

NER - Subroutine independent error flag

NRECN - The record number currently being processed on file DTI

LABELED COMMON /CHRCTR/

```
N1RA   = 1RA
N1RB   = 1RB
N1RC   = 1RC
N1RD   = 1RD
N1RE   = 1RE
N1RH   = 1RH
N1RI   = 1RI
N1RK   = 1RK
N1RL   = 1RL
N1RM   = 1RM
N1RN   = 1RN
N1RP   = 1RP
N1RR   = 1RR
N1RS   = 1RS
N1RT   = 1RT
N1RX   = 1RX
N1RY   = 1RY
N1RZ   = 1RZ
N1R0   = 1R0
N1R9   = 1R9
N1RPR  = 1R.
N1RDO  = 1R$
N1RAS  = 1R*
N1RSL  = 1R/
N1RPL  = 1R+
N1RMI  = 1R-
N1RCM  = 1R,
N1REQ  = 1R=
N1RLP  = 1R(
N1RRP  = 1R)
N1RBK  = 1R
```

LABELED COMMON /CONST/

NNODE - Number of nodes calculated in the preprocessor
NPAGE - Page number of the current page being written to the output file
NLINE - Line number of the last line written to the output file
MLINE - Maximum number of lines allowed on an output page less 3 lines
MR77 - Variable used in masking operations
MR67 - Variable used in masking operations
MR127 - Variable used in masking operations
MRBLK - Variable used in checking for blank characters
NBLANK - A word containing an all-blank Hollerith code
IR1WD - A word containing a code that will be the first word of each record written to a tape file
MAXBC - Maximum length of blank common
MAXF - Maximum core filed length possible for the run
NA - Contains the Hollerith code (N/A)
ISPCL - Denotes a special character decoded (-1RS)
INTEG - Denotes an integer word decoded (-1RI)
IFLT - Denotes a floating-point number decoded (-1RF)
NEREC - Number of binary records written to file DTI
NFTPRC - Number of tape feet pre-record (510*60 bits/rec)
= 0.30 (1600 bpi - 9-track)
= 0.55 (800 bpi - 7-track)
= 0.80 (556 bpi - 7-track)
MLABEL - Current edit modifier label
NONE - Contains the Hollerith code (none)
INPTSF - Multi-shadow factor input block flag

LABELED COMMON /CPCORE/

TCPST - Central processor (CP) time of start of preprocessor
TCPMC - CP time for model collect editing
ICRMC - Minimum core for model collect editing
TCPE - CP time for source editing
ICRE - Minimum core for source editing
TCPQ - CP time for compiling quantities data
ICRQ - Minimum core for compiling quantities data
TCPA - CP time for compiling array data
ICRA - Minimum core for compiling array data
TCPS1 - CP time for compiling surface data in pass 1
ICRS1 - Minimum core for compiling surface data in pass 1
TCPS2 - CP time for compiling surface data in pass 2
ICRS2 - Minimum core for compiling surface data in pass 2
TCPB - CP time for compiling BCS data
ICRB - Minimum core for compiling BCS data
TCPFF - CP time for compiling form factor data
ICRFF - Minimum core for compiling form factor data
TCPSW - CP time for compiling shadow data
ICRSW - Minimum core for compiling shadow data
TCPF - CP time for compiling flux data
ICRF - Minimum core for compiling flux data
TCPC - CP time for compiling correspondence data
ICRC - Minimum core for compiling correspondence data
TCPO - CP time for compiling operation data
ICRO - Minimum core for compiling operation data
TCPSR - CP time for initialization - RSTRTO and SQNTL
ICRSR - Minimum core initialization - RSTRTO and SQNTL
TCPD - CP time for processing documentation data block
ICRD - Minimum core for processing documentation data
TCPS - CP time for preprocessing subroutine data
ICRS - Minimum core for compiling subroutine data
TCPR - CP time for preprocessing restart data
ICRR - Minimum core for processing restart data
IPPST - Preprocessor (PP) time of start of preprocessor
IPPMC - PP time for model collect editing
IPPE - PP time for source editing
IPPQ - PP time for compiling quantities data
IPPA - PP time for compiling array data
IPPS1 - PP Time for compiling surface data in pass 1
IPPS2 - PP time for compiling surface data in pass 2
IPPB - PP time for compiling BCS data
IPPFF - PP time for compiling form factor data
IPPSW - PP time for compiling shadow data
IPPF - PP time for compiling flux data
IPPC - PP time for compiling correspondence data
IPPO - PP time for compiling operations data
IPPSR - PP time for initialization of SQNTL and RSTRTO
IPPO - PP time for processing documentation data block
IPPS - PP time for compiling subroutine data
IPPR - PP time for compiling restart data

LABELED COMMON /CVCONS/

NBITS - Maximum number of bits in a computer word

NBITC - Maximum number of bits in a Hollerith character

NW1T72 - Minimum number of computer words to read in Col. 1 thru Col. 72 of an input card

NW7T72 - Minimum number of computer words to read in Col. 7 thru Col. 72 of an input card

NCHAR - Number of Hollerith characters in a computer word

LABELED COMMON /CVFAC/

DTR - Degrees to radians

RTD - Radians to degrees

PI - PI

LABELED COMMON /DIMES/

NSRFC - Number of surfaces read in by the preprocessor

NWDSMX - Maximum number of words on longest surface record

NOFBCS - Number of BCS read in by the preprocessor

NTSPSF - Total number of specular surfaces

LABELED COMMON /ERROR/

NERR - Total number of errors detected by the preprocessor
NCTN - Total number of cautions detected by the preprocessor
IERR - Number of error words filed in the KERR array
ICTN - Number of caution words filed in the KCTN array

LABELED COMMON /FILE/

NSC1 - Scratch sequential file 1
NSC2 - Scratch sequential file 2
NSC3 - Scratch sequential file 3
NDI - Output of source editor and input to preprocessor
NIN - Card reader input file
NOUT - Printer output file
NRIO - Main working random I/O file
NRIOS - Scratch random I/O file
NEDI - Source edit input file
NEDO - Source edit output file
NCMG - Card input merge file
NEMG - Edit input merge file
NRSI - Restart file input (permanent)
NRSO - Restart file output (permanent)
NSQNTL - Sequential communication file
NRTI - Restart file input (temporary)
NCMPL - Generated FORTRAN program output file
NFFR - Form factor restart file
NDIR - Flux data restart file
NGBIRR - Correspondence data file
NGBSOR - Not used
NPLSR - Shadow factor restart file
NTQR - Not used
NSHADI - Shadow factor input tape
NSHADO - Shadow factor output tape
NTRAJ - Trajectory input tape
NUSER1 - User file 1
NUSER2 - User file 2
NFF - Not used
NDILB - Not used
NGBIR - Not used
NGBSO - Not used
NPLS - Shadow factor file for processor
NTQ - Not used
NRTO - Restart file output (temporary)
NBCDOU - MITAS-SINDA BCD interface tape

LABELED COMMON /FNAME/

These variables are used to transfer file information from the options card read-in routine to the edit and history routines

JEDI = 1H
JCMG = 1H
JEMG = 1H
JEDO = 1H
JRSI = 1H
JRSO = 1H
JRTI = 1H
JRTO = 1H
JSHADI = 1H
JSHADO = 1H
JBCDOU = 1H
JTRAJ = 1H
JUSER1 = 1H

LABELED COMMON /HEAD/

LMDTE - Date of last modification
NVRSN - Current TRASYS version and modification number
NDTE - Job run date
NTME - Job run start time
NJOB - Job number
NTITLE - Array containing the TRASYS internal title that is printed at the top of each output page
ITITLE - Array containing the user-input title for the primary model. This title is printed at the top of each printed page

LABELED COMMON /OPTION/

IRSTART - Flag for designating a restart or start run
IPRNTS - Flag for type of source edit printing
IPNCHS - Flag for type of source edit punching
IGO - Flag for editing and preprocessing the data, or just editing the data and terminating
IPRNTE - Flag for type of edit directive output
IRLBLS - Flag for relabeling the source
MDLNM - Primary model name that is to be processed
MDLNNM - Input model name to be changed to MDLNNM after editing
IDMPD - Flag for printing documentation data block
IERCNT - Preprocessor error - normal continuation flag
MAXBCP - Processor dynamic storage allocator
ERPLOT - Generate node plot in case of errors

LABELED COMMON /RNDMIO/

MRREC - Maximum number of records that can be written to the random I/O file

NRREC - Number of records that have been written to the random I/O file

NRCQV - Random I/O record that the control constant value array is written to

NLCQV - Number of words in the control constant value array record

NRUQD - Random I/O record that the user constant directory array record is written to

NLUQD - Number of words in the user constant directory array record

NRUQV - Random I/O record that the user constant value array is written to

NLUQV - Number of words in the user constant value array record

NRAND - Random I/O record that the user array name directory array is written to

NRAPD - Random I/O record that the user array position directory array is written to

NLAD - Number of words in the user array directory array record

NRAV - Random I/O record that the user array value array is written to

NLAV - Number of words in the user array value array record

NRIS - Random I/O record that the surface index is written to

NLIS - Number of words in the surface index record

NRIN - Random I/O record that the node index is written to

NLIN - Number of words in the node index record

NRBCSD - Random I/O record that the BCS directory is written to

NLBCSD - Number of words in the BCS directory record

NRBCSR - Random I/O record that the BCS index record is written to

NLBCSR - Number of words in the BCS index record

NRSD - Random I/O record that the step directory is written to

NLSD - Number of words in the step directory

NRTD - Random I/O record that the combined directory is written to

NLTD - Number of words in the combined directory

NRBCSN - Random I/O record that the BCS names are written to

NLBCSN - Number of BCS names written to the NRBCSN record

LABELED COMMON /RNDMRC/

NRT - Random I/O record that the title array is written to
NLT - Number of words in the title array record
NRCQD - Random I/O record that the control constant directory array is written to
NLCQD - Number of words in the control constant directory

LABELED COMMON /TRACE/

ITRC12 - Trace printout flag for segment MCOLL
ITRCED - Trace printout flag for segments SEDIT & GNEDO
ITRCDM - Not used
ITRC21 - Trace printout flag for segment QUANRD
ITRC22 - Trace printout flag for segment ARRYRD
ITRC23 - Trace printout flag for segment SKIRD
ITRC24 - Trace printout flag for segment SRFCRD
ITRC25 - Trace printout flag for segment SDPSS2
ITRC26 - Trace printout flag for segment BCSRD
ITRC27 - Not used
ITRC28 - Trace printout flag for segment FRMFRD
ITRC29 - Trace printout flag for segments FLUXRD and CRSPRD
ITRC31 - Trace printout flag for segment LOGIC1
ITRC32 - Trace printout flag for segment LOGIC2
ITRC33 - Trace printout flag for segment LOGIC3
ITRCTG - Trace printout flag for segment TPGEN
ITRCRS - Trace printout flag for segment RESTRT
ITRCON - Trace flag to be checked for
ITRCSF - Trace printout flag for segment SHDWRD

III. PART 2 - PROCESSOR LIBRARY

A. SEGMENT DEFINITIONS

SEGMENT DEFINITIONS - PROCESSOR LIBRARY

III. PART 2 - PROCESSOR LIBRARY

A. SEGMENT DEFINITIONS

SEGMENT NAME: AQCAL

PURPOSE: This segment computes absorbed heat rates in two wavebands, accounting for specular and diffuse reflection (Fig. III-1).

RESTRICTIONS: Appropriate direct-irradiation and gray-body factors must be located on the DI, GBIR, and GBSO files before execution.

CALLING SEQUENCE: L AQCAL

OUTPUT: Absorbed total heat rates written to file TQ.

SEGMENT NAME: DICAL

PURPOSE: This segment computes solar, planetary, and albedo irradiation incident on spacecraft nodes (Fig. III-2).

RESTRICTIONS: Execution is possible after previous calls have been made to define spacecraft geometry, location in space, characteristics and distances of heat source bodies, and computation accuracy parameters.

CALLING SEQUENCE: L DICAL

OUTPUT: Printed, punched, written to files DI, RTO, and PLS.

SEGMENT NAME: FFCAL

PURPOSE: This segment calculates all form factors for the active configuration (Fig. III-4).

RESTRICTIONS: None

CALLING SEQUENCE: L FFCAL

OUTPUT: Printed, punched, written to file FF.

PRECEDING PAGE BLANK NOT FILMED

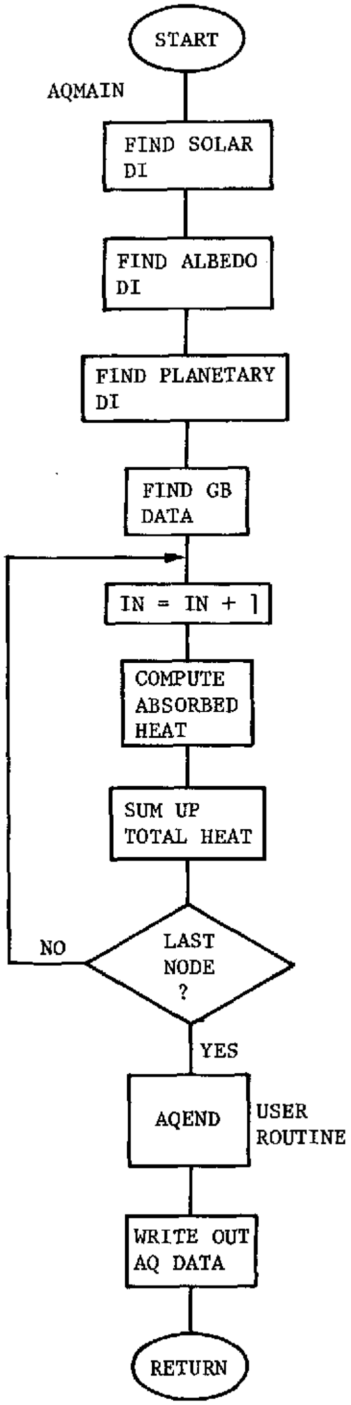
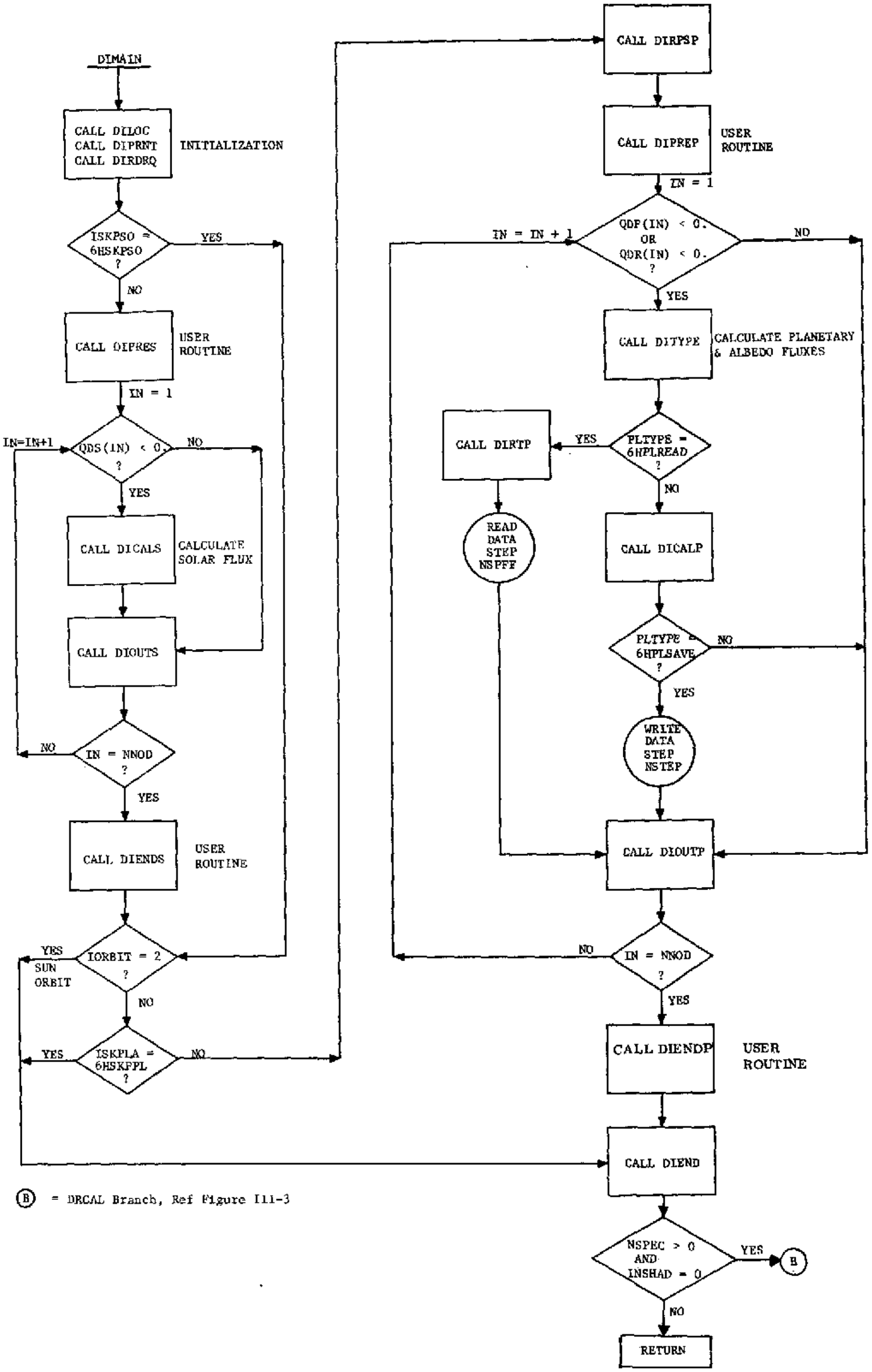


Figure III-1 Segment AQCAL Flow Diagram



(B) = DRCAL Branch, Ref Figure III-3

Figure III-2 Segment DICAL Flow Diagram

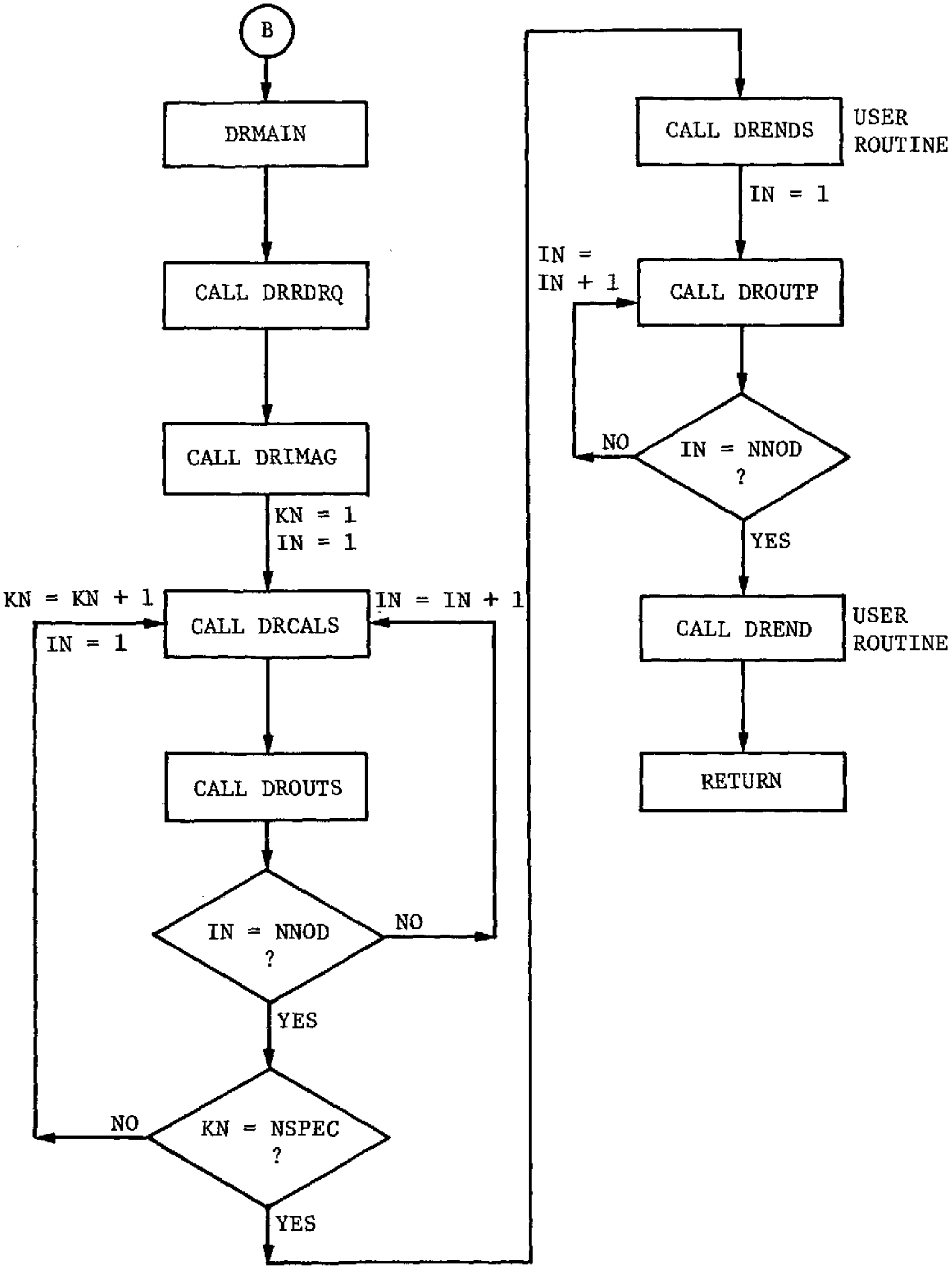
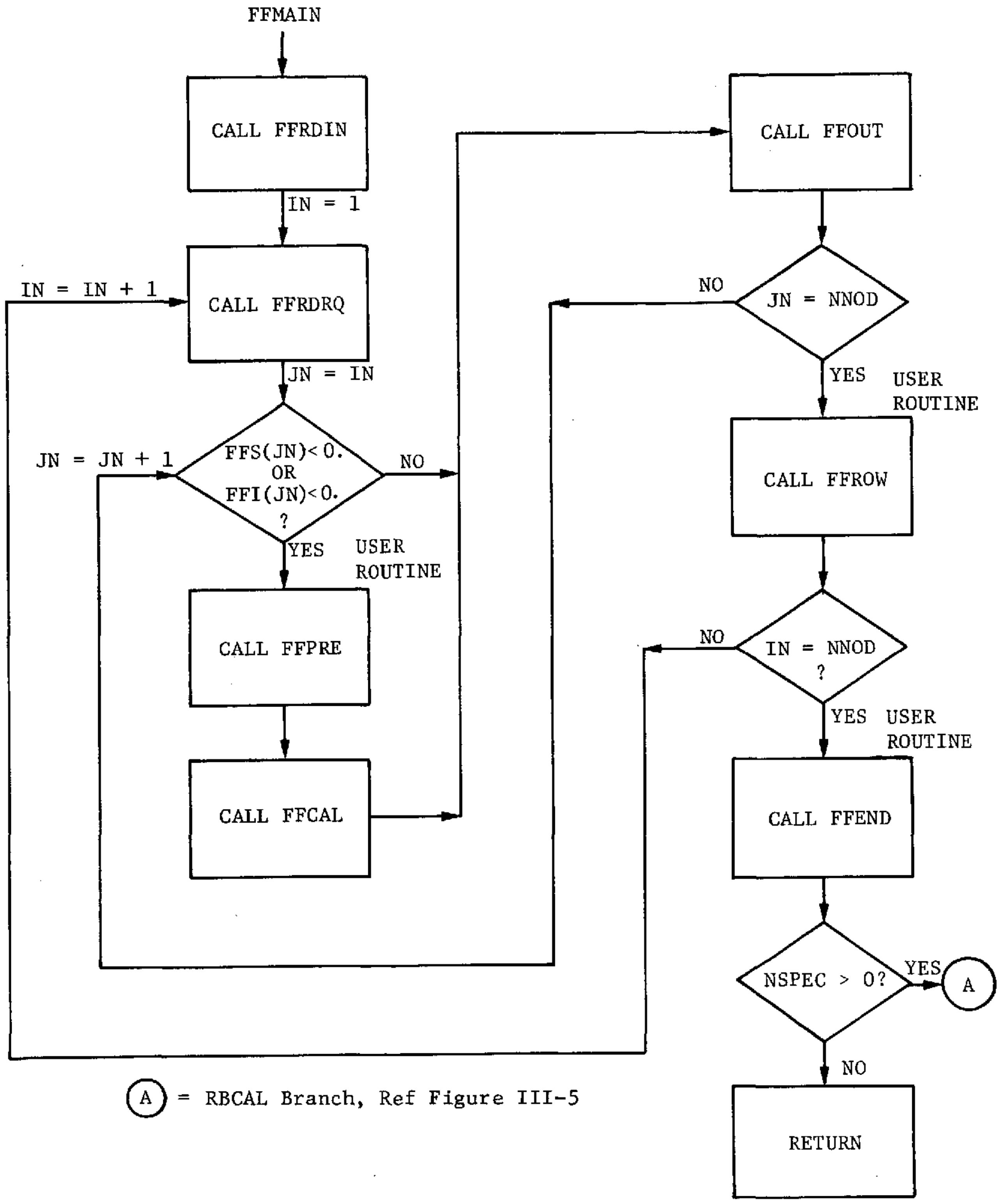


Figure III-3 Segment DRCAL Flow Diagram



(A) = RBCAL Branch, Ref Figure III-5

Figure III-4 Segment FFCAL Flow Diagram

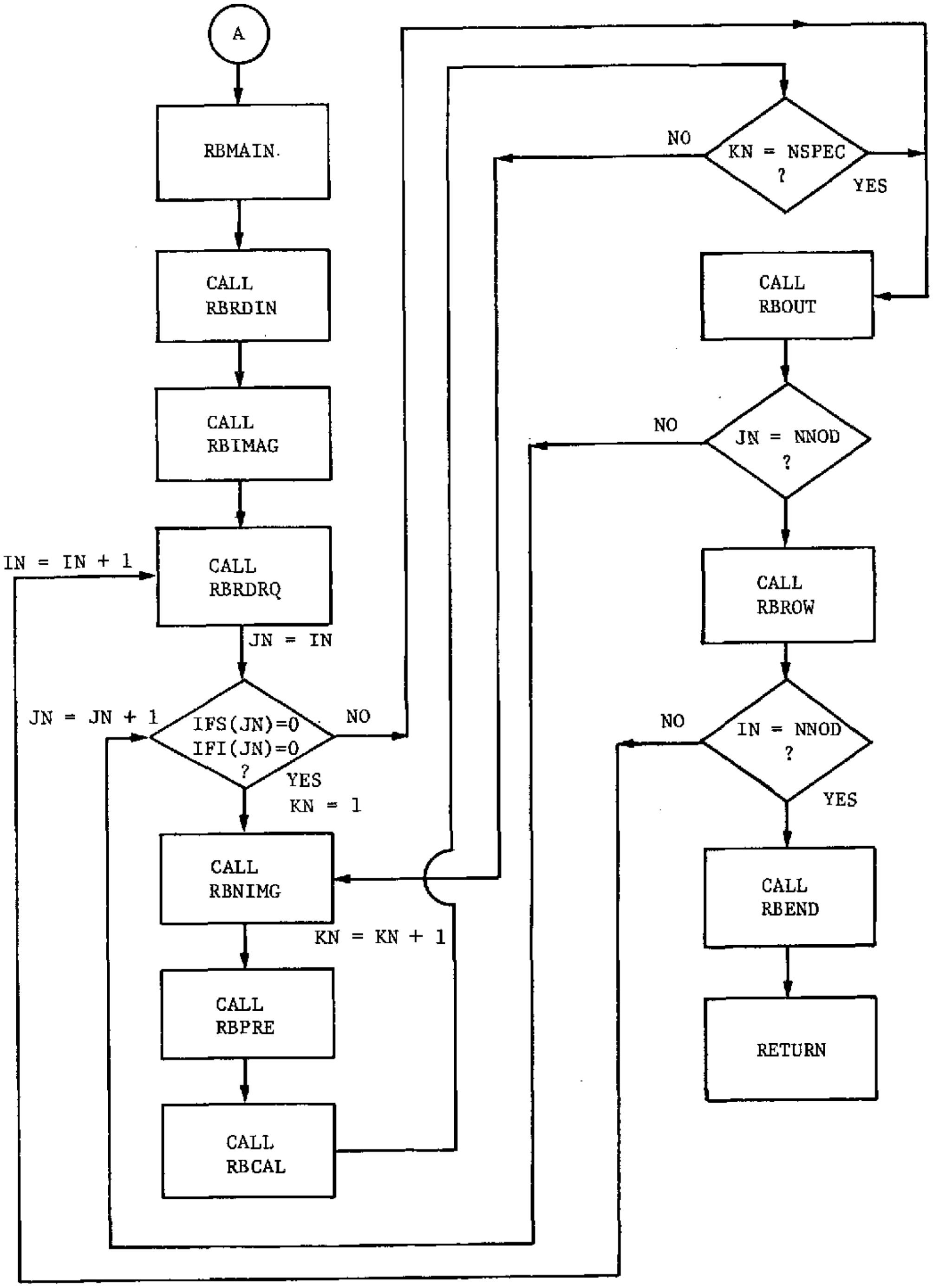


Figure III-5 Segment RBCAL Flow Diagram

SEGMENT NAME: GBCAL

PURPOSE: This segment computes and stores the gray-body factor matrix (Fig. III-6).

RESTRICTIONS: Requires form factor data on file FF.

CALLING SEQUENCE: L GBCAL

OUTPUT: Writes gray-body factor matrices to GBIR and/or GBSO.

SEGMENT NAME: NPLOT

PURPOSE: This segment generates pictorial plots of nodal surfaces (Fig. III-7).

RESTRICTIONS: None

CALLING SEQUENCE: L NPLOT

OUTPUT: Printed, plot file.

SEGMENT NAME: OPLOT

PURPOSE: This segment generates pictorial plots of the spacecraft in orbit (Fig. III-8).

RESTRICTIONS: None

CALLING SEQUENCE: L OPLOT

OUTPUT: Printed, plot file.

SEGMENT NAME: PLOT

PURPOSE: This segment generates function vs time plots of absorbed and incident heat rates and fluxes. When used in conjunction with operations block FORTRAN that writes data to a plot data unit, this segment provides a general x vs y plot capability (Fig. III-9).

RESTRICTIONS: Reference Subroutine PLDATA

CALLING SEQUENCE: L PLOT

OUTPUT: Printed, plot file.

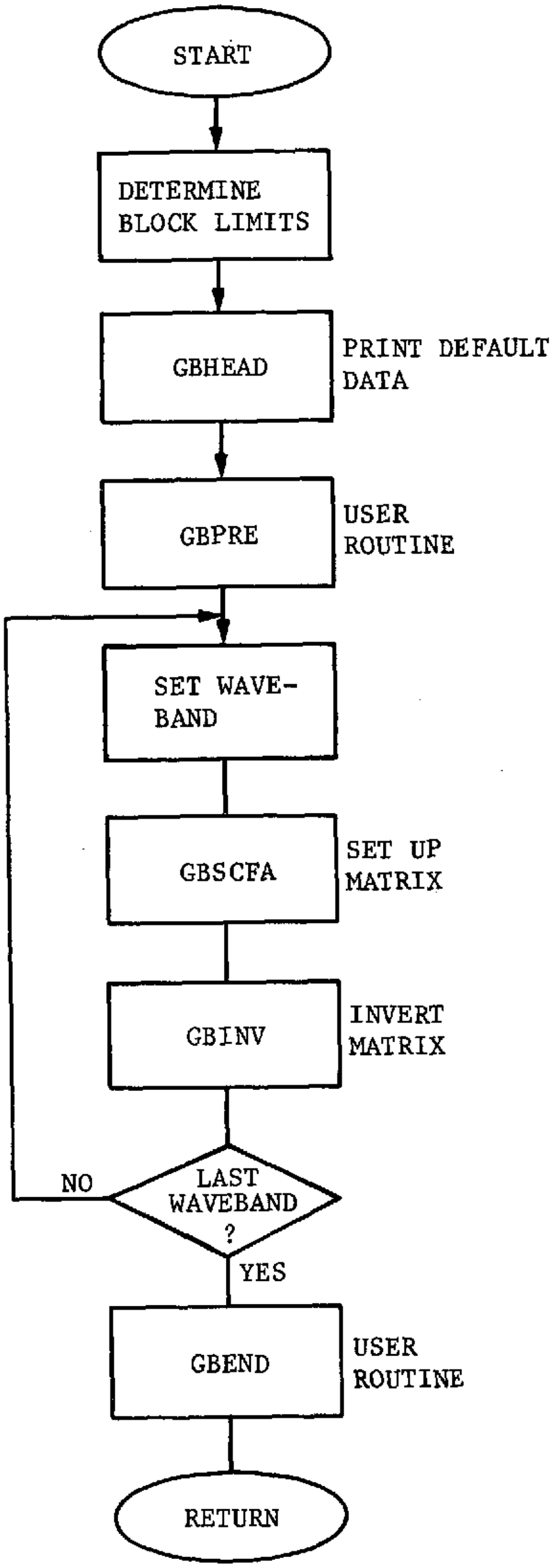


Figure III-6 Segment GBCAL Flow Diagram

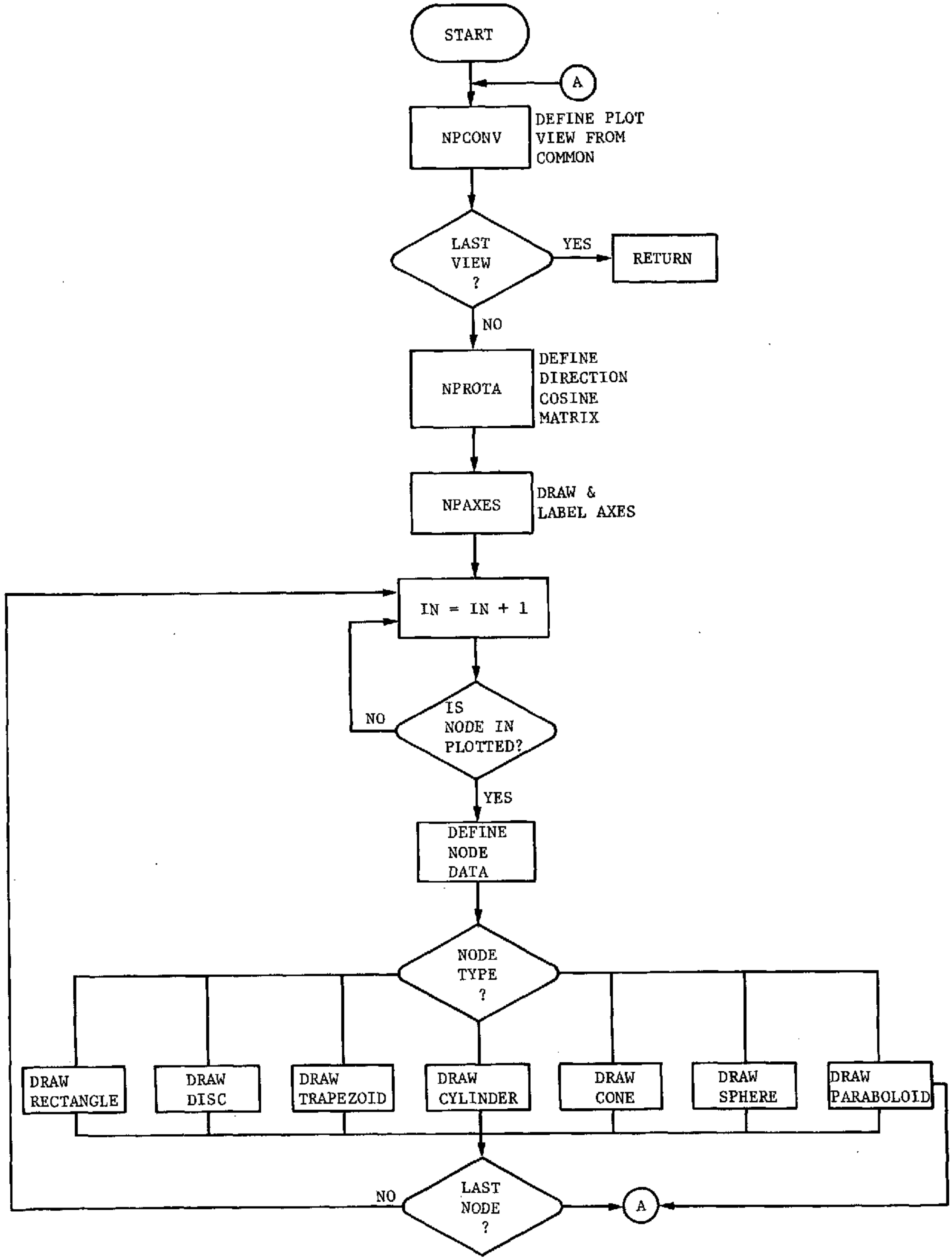


Figure III-7 Segment NPLOT Flow Diagram

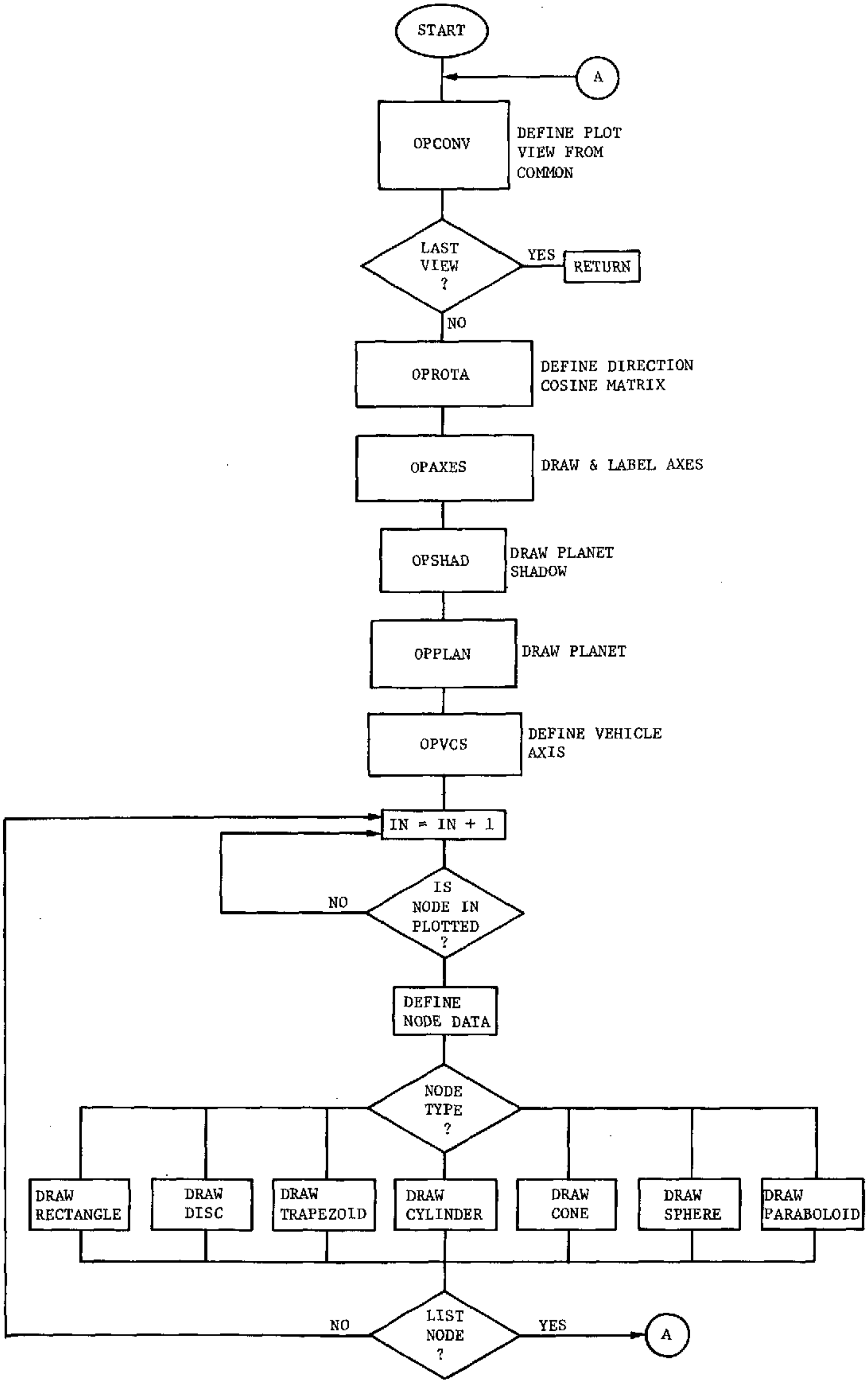


Figure III-8 Segment OPLOT Flow Diagram

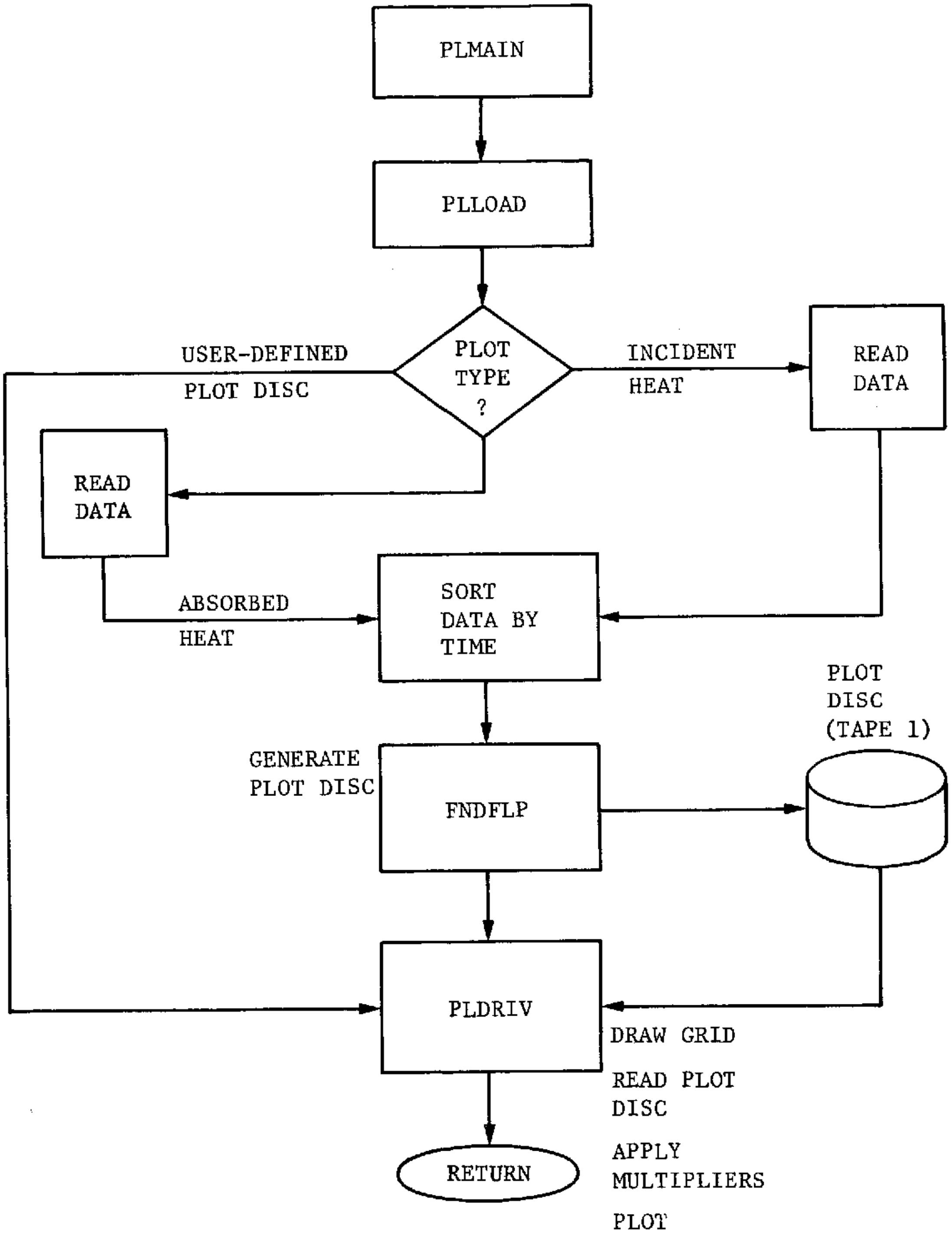


Figure III-9 Segment PLOT Flow Diagram

SEGMENT NAME: QOCAL

PURPOSE: This segment accesses absorbed flux data and generates orbital average and absorbed flux vs time arrays (Fig. III-10).

RESTRICTIONS: Requires data on the TQ file.

CALLING SEQUENCE: L QOCAL

OUTPUT: Printed, punched, BCD tape (File BCDOU).

SEGMENT NAME: RCCAL

PURPOSE: This segment computes radiation conductors and simplifies and condenses these conductors using the ERN and MESS techniques (Fig. III-11).

RESTRICTIONS: Requires data on the GBIR file.

CALLING SEQUENCE: L RCCAL

OUTPUT: Printed, punched, BCD tape (file BCDOU).

SEGMENT NAME: RKCAL

PURPOSE: This segment computes radiation conductor values (Fig. III-12).

RESTRICTIONS: Requires data on the GBIR file.

CALLING SEQUENCE: L RKCAL

OUTPUT: Printed, punched, BCD tape (file BCDOU).

SEGMENT NAME: SFCAL

PURPOSE: This segment computes tables of internode blockage (shadow) factors for use in direct irradiation calculations. When a complete shadow factor tape supplied, SFCAL is executed to pass the shadow tables to file PLSR and initialize DICAL to compute irradiations using the shadow tables (Fig. III-13).

RESTRICTIONS: None

CALLING SEQUENCE: L SFCAL

OUTPUT: Printed, binary tape (files NPLS and SHADO).

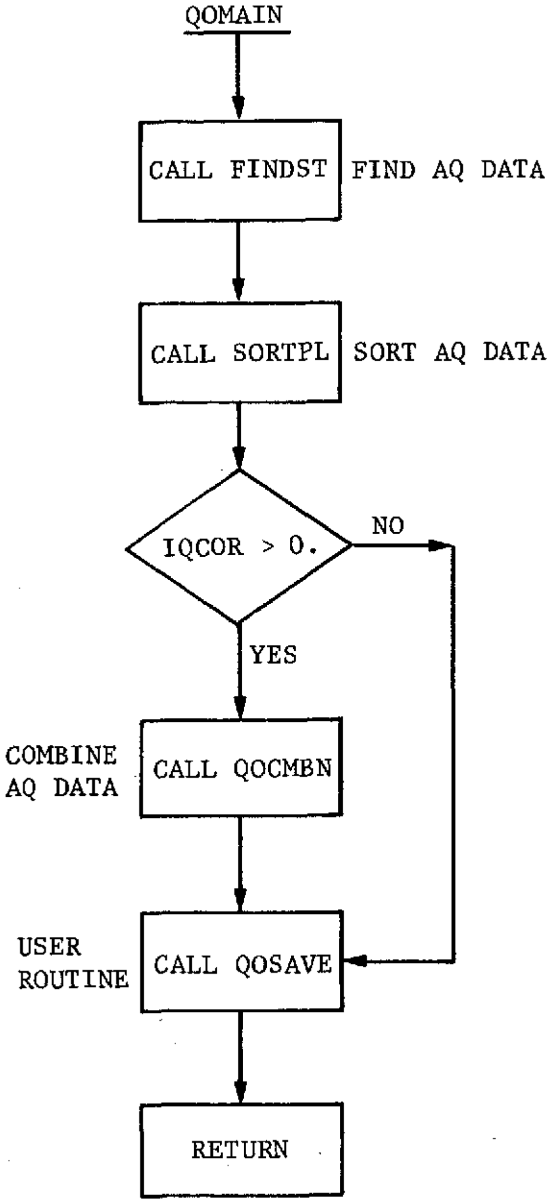


Figure III-10 Segment QOCAL Flow Diagram

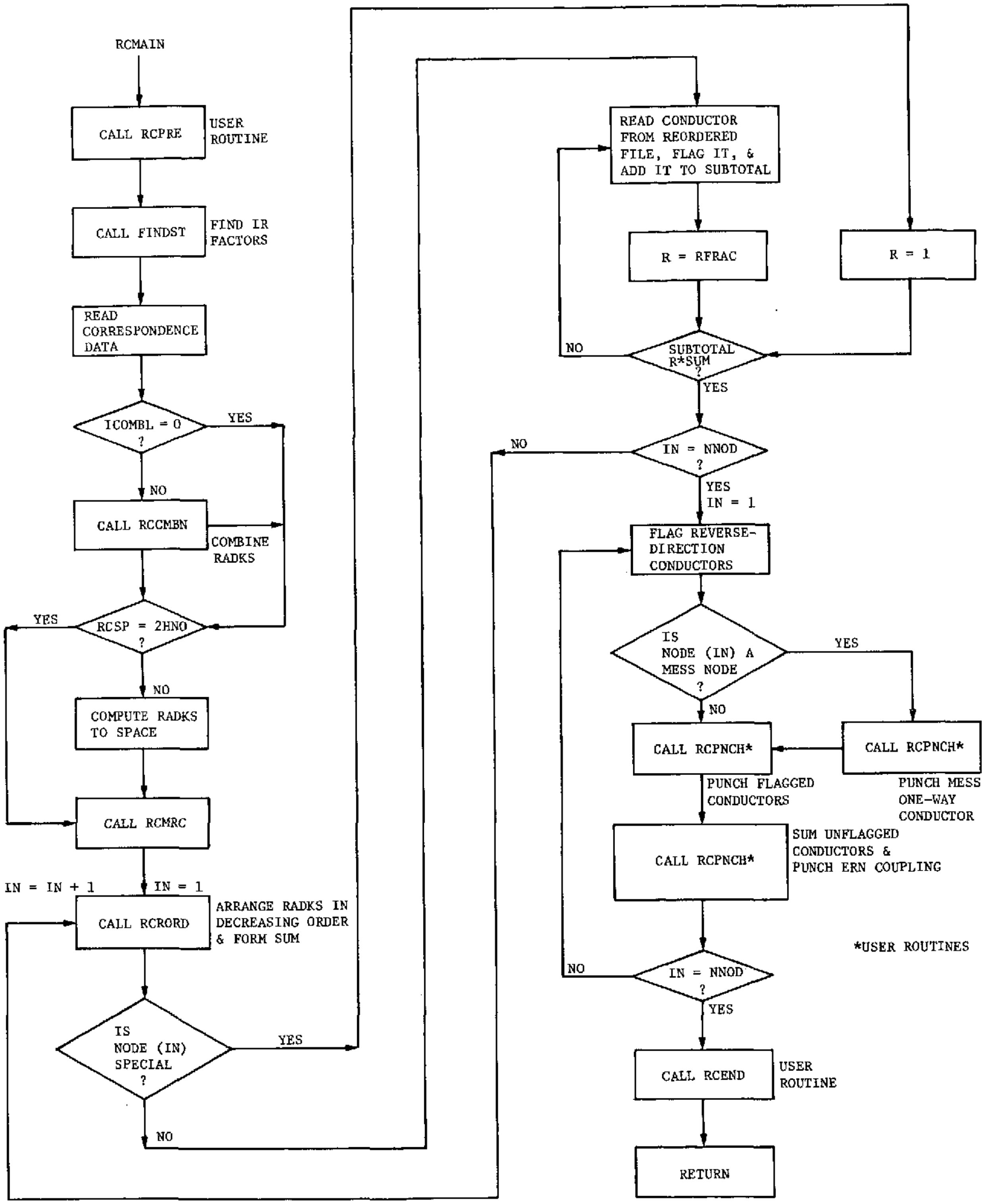


Figure III-11 Segment RCCAL Flow Diagram

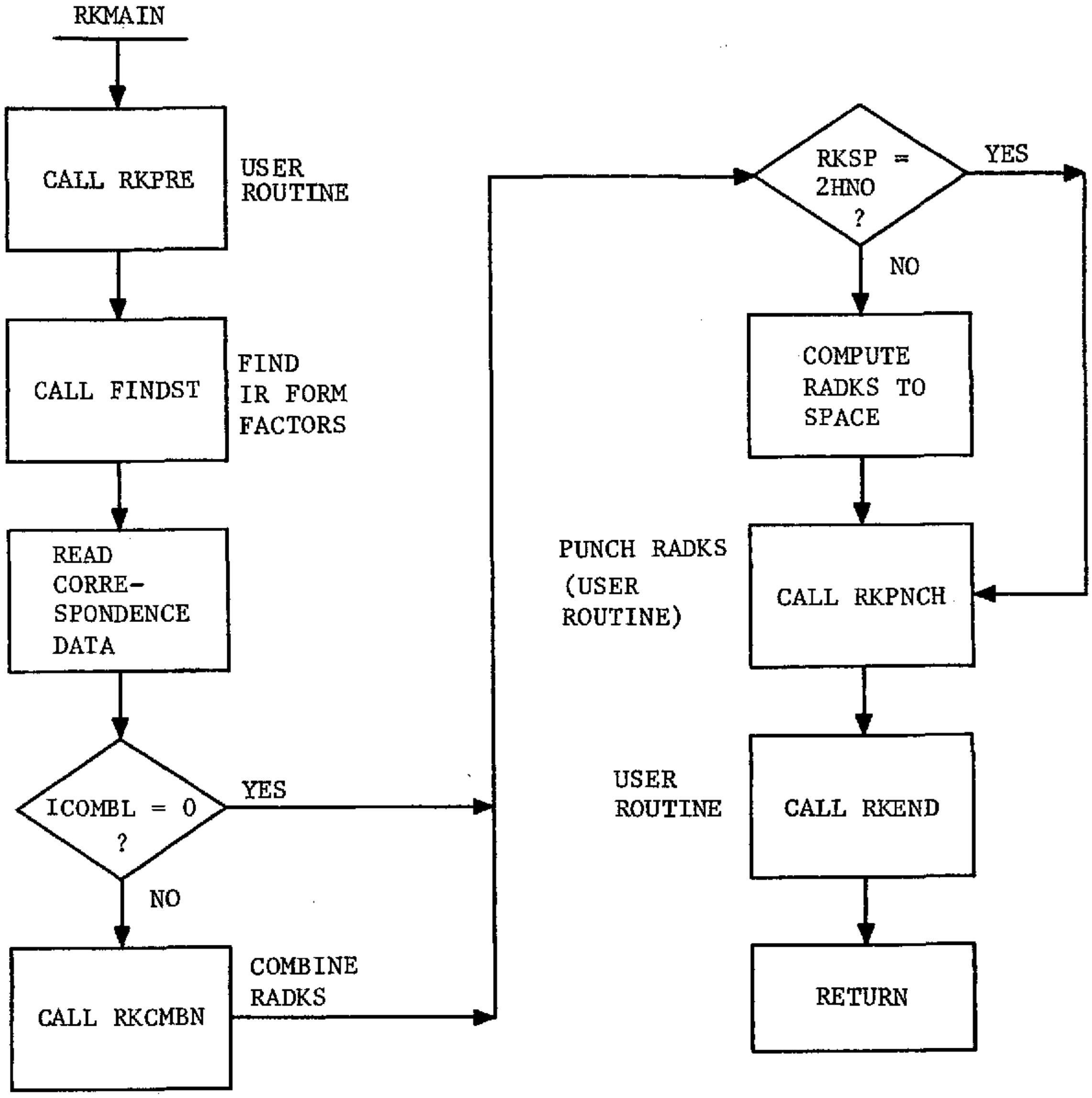


Figure III-12 Segment RKCAL Flow Diagram

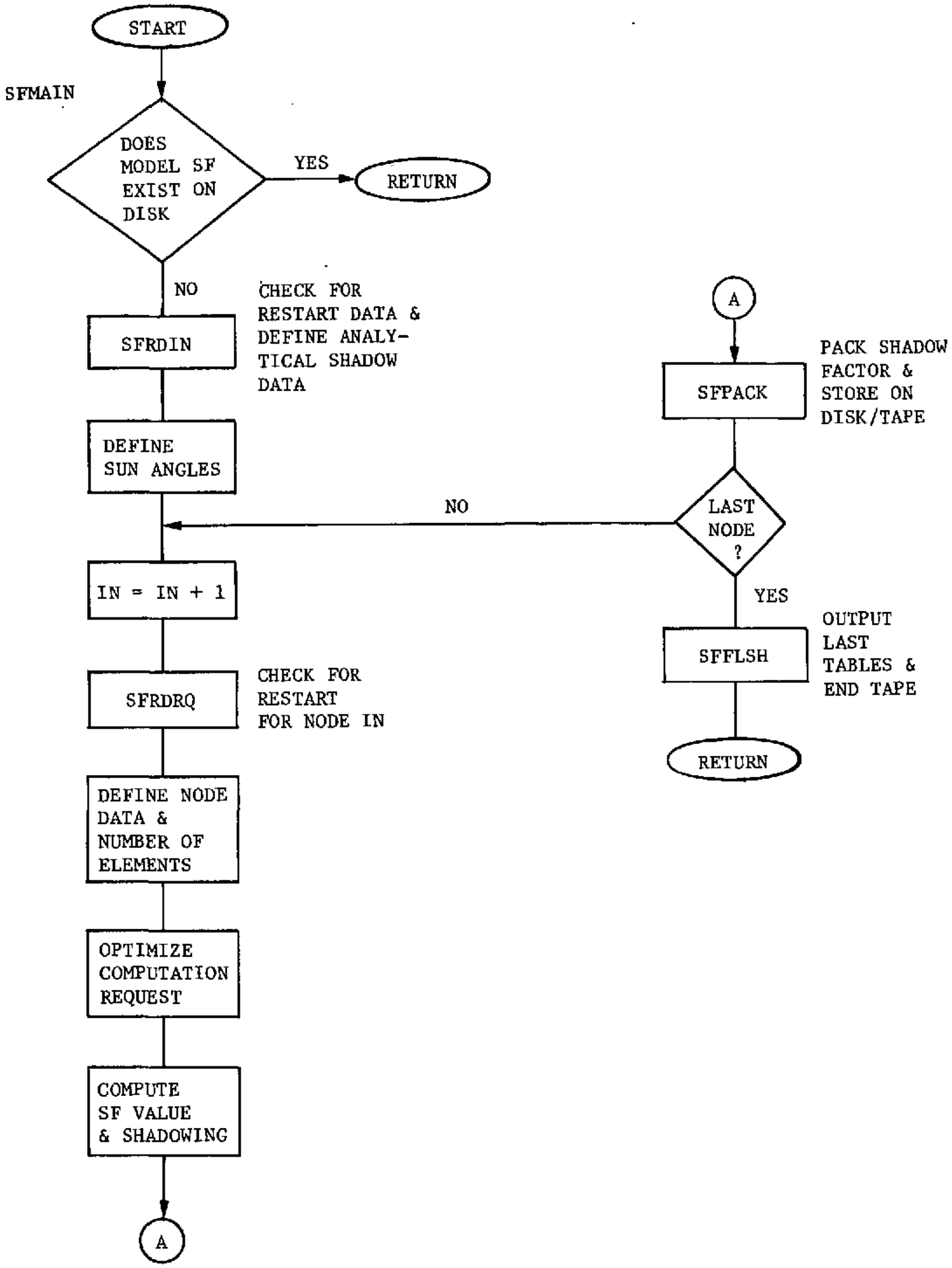

START
SFMAIN
DOES MODEL SF EXIST ON DISK
YES
RETURN
NO
SFRDIN
CHECK FOR RESTART DATA & DEFINE ANALYTICAL SHADOW DATA
DEFINE SUN ANGLES
IN = IN + 1
SFRDRQ
CHECK FOR RESTART FOR NODE IN
DEFINE NODE DATA & NUMBER OF ELEMENTS
OPTIMIZE COMPUTATION REQUEST
COMPUTE SF VALUE & SHADOWING
A
A
SFPACK
PACK SHADOW FACTOR & STORE ON DISK/TAPE
LAST NODE ?
NO
YES
SFFLSH
OUTPUT LAST TABLES & END TAPE
RETURN

Figure III-13 Segment SFCAL Flow Diagram

B. SUBROUTINE AND FUNCTION DESCRIPTIONS - PROCESSOR LIBRARY

SUBROUTINE AND FUNCTION DESCRIPTIONS
- PROCESSOR LIBRARY

B. SUBROUTINE AND FUNCTION DESCRIPTIONS - PROCESSOR LIBRARY

ROUTINE NAME: ABSBEA

DESCRIPTION: This routine locates plotting beam at the absolute raster coordinate (X, Y) based on $0.0 \leq X, Y \leq 1.0$.

CALLING SEQUENCE: CALL ABSBEA (X, Y)

REFERENCES: NPMAIN, NPINFO, OPMAIN, OPINFO, PLGRID

ROUTINE ANME: ADD

DESCRIPTION: This routine adds additional nodes/surfaces to the existing configuration (see BUILDC).

CALLING SEQUENCE: CALL ADD (BCSN)

BCSN - Left-justified, blank-filled block coordinate system name

REFERENCES: User call in the Operations Data block

FILES: NRAN

ROUTINE NAME: AQDATA

DESCRIPTION: This is a user-called routine to define control constants.

CALLING SEQUENCE: CALL AQDATA (IGBI, IGBS, RS, RA, RP)

IGBI - Step number containing gray-body IR
IGBS - Step number containing gray-body SOLAR
RS - Solar multiplier
RA - Albedo multiplier
RP - Planetary multiplier

REFERENCES: ODPROG (user's operations data)

ROUTINE NAME: AQEND

DESCRIPTION: Routine for user logic before termination to AQCAL link.

REFERENCES: AQMAIN

ROUTINE NAME: AQMAIN

DESCRIPTION: This routine computes absorbed Q data from direct incident data and solar/IR gray bodies and stores the data on file NTQ.

KEY VARIABLES: QAS - Absorbed solar array
QAR - Absorbed albedo array
QAP - Absorbed planetary array
GBIR - Gray-body IR array
GBSO - Gray-body solar array
QDS - Direct solar
SDR - Direct albedo
SDP - Direct planetary

REFERENCES: AQPROG

FILES: Reads NGBIR and NGBSO, NDI writes NTQ

ROUTINE NAME: AQNCK

DESCRIPTION: This routine checks the node array on the data file with the active node array to determine if they contain the same configuration. If the configurations are different, AQNCK outputs both arrays and aborts, if both configurations are the same, it returns to the main program.

CALLING SEQUENCE: CALL AQNCK (ITEMP, N1)

ITEMP - Array of node numbers from data file
N1 - Number of nodes

KEY VARIABLES: NODE - Node number array of actual configuration
NNOD - Number of active nodes in configuration

REFERENCES: AQMAIN

ROUTINE NAME: AQPRE

DESCRIPTION: This is a user-called routine in the AQCAL link prior to any computations.

REFERENCES: AQMAIN

ROUTINE NAME: AQPROG

DESCRIPTION: This routine is generated by the preprocessor to call into AQMAIN and the remainder of the link.

KEY VARIABLES: AQQDS - Long direct solar in array NNOD
AQQDR - Long direct albedo in array NNOD
AQQDP - Long direct planetary in array NNOD
QAS - Long absorbed solar in array NNOD
QAR - Long absorbed albedo in array NNOD
QAR - Long absorbed planetary in array NNOD
GBSO - Long gray-body solar in array NNOD
GBIR - Long gray-body IR in array NNOD
AQTEMP - Working storage area in array NNOD

ROUTINE NAME: BANNLB

DESCRIPTION: This routine writes the TRASYS processor banner on the output file.

REFERENCES: RDMAIN

ROUTINE NAME: BLDPLT

DESCRIPTION: This routine reads plot data from scratch disk 1 (NSCR1) and writes plot data in the proper format on output and plot disk IPLUNT. It also scales the X and Y values.

CALLING SEQUENCE: CALL BLDPLT (DATA, NV, NTIME, TIME)

DATA - Working storage array
NV - Number of lines per grid
NTIME - Number of data points per line
TIME (1, x) - Independent variable (time)
TIME (2, x) - Associated step number

REFERENCES: PLLOAD

FILES: NSCR1 is defined in PLLOAD. IPLUNT is written in plot format

ROUTINE NAME: BUILDC

DESCRIPTION: This routine activates and initializes the configuration 1 block coordinate system name per call. It also defines arrays NODE, AREA, EMISS, TRIR, TRSO, SRIR, and SRSO, and initializes configuration counters NN, NS, NSPEC, and NONLY.

CALLING SEQUENCE: CALL BUILDC (BCSN)/CALL ADD (BCSN)

BCSN - Left-justified, blank-filled block coordinate system name

INDXS - Array of random access record pointers to active surfaces defined by BUILDC/ADD

KEY VARIABLES: INDXN - Array of random access record pointers to active nodes defined by BUILDC/ADD

NN - Number of nodes plus shadower-only nodes

NS - Number of surfaces

NSPEC - Number of specular surfaces

NNOD - Number of nodes

NSPEC - Number of surfaces

NSURF - Number of surfaces

NONLY - Number of shadower surfaces

REFERENCES: User-called in the operations data block only

FILES: NRAN

ROUTINE NAME: CHGBLK

DESCRIPTION: This routine reads block coordinate system data (translations and rotations) from random access file NRAN, redefines them, rewrites them to the NRAN file, and flags the BCS directory that the BCS has been changed.

CALLING SEQUENCE: CALL CHGBLK (NAME, X, Y, Z, NROTX, NROTY, NROTZ, ROTX, ROTY, ROTZ)

NAME - BCS name

X - Translation X

Y - Translation Y

Z - Translation Z

NROTX - Rotation order of X

NROTY - Rotation order of Y

NROTZ - Rotation order of Z

ROTX - Rotation angle X

ROTY - Rotation angle Y

ROTZ - Rotation angle Z

KEY VARIABLES: NBLKDR (1, I) - BCS name

(2, I) - Length of block

(3, I) - Random record number

(4, I) - Flag transform has been applied

REFERENCES: User-called in the Operations Data block

FILES: NRAN - Rewritten

ROUTINE NAME: CROSS

DESCRIPTION: This routine forms a vector cross-product of the form.

CROS = VEC1 x VEC2

CALLING SEQUENCE: CALL CROSS (VEC1, VEC2, CROS)

VEC1 (3) - X, Y, Z in array
VEC2 (3) - X, Y, Z in array
CROS (3) - X, Y, Z in array

REFERENCES: DILOC2

ROUTINE NAME: DICALP

DESCRIPTION: This routine computes the direct incident albedo radiation QDR (IN) and direct planetary radiation QDP (IN), forms an optimum elemental grid based on altitude and node positions/shadowing, and saves elemental planetary factors on disk and applies shadowing. It is the main control routine for computing albedo and planetary radiation.

KEY VARIABLES:

SHADR	- Shadow factor for albedo
SHADP	- Shadow factor for planetary
SUMR	- Elemental albedo factors
SUMP	- Elemental planetary factors
QDR (IN)	- Complete incident albedo for Node IN
QDP (IN)	- Complete incident planetary for Node IN
ISFT	- Flag to indicate shadow factor tape
PLTYPE	- Flag to indicate to save or read planet elemental factors

REFERENCES: DITYPE

FILES: NPLS

ROUTINE NAME: DICALS

DESCRIPTION: This is the main controlling routine to compute direct incident fluxes. It forms an optimum elemental grid based on position and shadowing.

KEY VARIABLES: ISFT - Flag to indicate shadow factor tape
SHADS - Shadow factor
QDS (IN) - Incident solar flux for Node IN

REFERENCES: DIMAIN

FILES: None

ROUTINE NAME: DICCV

DESCRIPTION: This routine defines the position vector, given clock and cone angles and the vector magnitude.

CALLING SEQUENCE: CALL DICCV (VMAG, CL, CO, PVEC)

VMAG - Magnitude
CL - Clock angle in degrees
CO - Cone angle in degrees
PVEC(3) - Position vector

REFERENCES: DILOC2

ROUTINE NAME: DICOMB

DESCRIPTION: This routine performs a matrix multiplication of the form

$$A \cdot B = C$$

where
A, B, and C are 3 x 3 matrices.

CALLING SEQUENCE: CALL DICOMB (A, B, C)

A - 3 x 3 matrix
B - 3 x 3 matrix
C - Resultant 3 x 3 matrix

REFERENCES: DILOC, DILOC2

ROUTINE NAME: DICOMP

DESCRIPTION: This is a user routine to define compute flag or step numbers.

CALLING SEQUENCE: CALL DICOMP (IS, IA, IP)

IS - Solar flag to compute, zero, and retrieve data
IA - Albedo flag to compute, zero, and retrieve data
IP - Planetary flag to compute, zero, and retrieve data

REFERENCES: User-called routines in the Operations Data block

ROUTINE NAME: DIDCS

DESCRIPTION: This routine computes direction cosines, given the angles X, Y, and Z and the order to perform the rotations.

CALLING SEQUENCE: CALL DIDCS (II, JJ, KK, PHI, PSI, OMI, TRAN)

II	- Order of rotations (1st rotation)
JJ	- Order of rotations (2nd rotation)
KK	- Order of rotations (3rd rotation)
PHI	- Rotation angle Z
PSI	- Rotation angle Y
OMI	- Rotation angle Z
TRAN (3,3)	- Resultant direction-cosine matrix

REFERENCES: None

ROUTINE NAME: DIDENT

DESCRIPTION: This routine generates a 3 x 3 identity matrix in A.

CALLING SEQUENCE: CALL DIDENT (A)

A - 3 x 3 array with $i = j = 1$, $i \neq j = 0$

REFERENCES: DILOC

ROUTINE NAME: DIDT1

DESCRIPTION: This is a user-called routine to define the DI link parameters.

CALLING SEQUENCE: See users manual, Appendix D

REFERENCES: User-called routine in the Operations Data block

ROUTINE NAME: DIDT1S

DESCRIPTION: This is a user-called routine to define the DI link parameters.

CALLING SEQUENCE: See users manual, Appendix D

REFERENCES: User called routine in the Operations Data block

ROUTINE NAME: DIDT2

DESCRIPTION: This is a user-called routine to define the DI link parameters.

CALLING SEQUENCE: See users manual, Appendix D

REFERENCES: Operations Data, user-called

ROUTINE NAME: DIDT2S

DESCRIPTION: Short form call to define DI link parameters.

CALLING SEQUENCE: See users manual, Appendix D

REFERENCES: User-called routine in the Operations Data block

ROUTINE NAME: DIELEM

DESCRIPTION: Computes position and area vectors for all elements on a surface given the number of elements in each direction on a node.

CALLING SEQUENCE: CALL DIELEM (ILP, DATA, TRAN, RX, RY, RZ, NTOT)

ILP - Type of geometric node
DATA(5) - Dimensions of node
TRAN(3,3) - Direction cosines of node
RX, RY, RZ - Translation vector
NTOT - Number of elements node is to be divided into

KEY VARIABLES: NEST - Number of elements (maximum = 400)
SFPV (400, 3) - Node elemental position vector
SFAV (400, 3) - Node elemental normal vector

REFERENCES: DICALS, DICALP

ROUTINE NAME: DIELSL

DESCRIPTION: This routine computes the number of elements in two directions on a node to give square elements, given the total number required.

CALLING SEQUENCE: CALL DIELSL (NB, NG, ILP, DATA, NTOT)

NB - Computed number of elements in beta direction
NG - Computed number of elements in gamma direction
ILP - Surface type
DATA(5) - Nodal dimensions
NTOT - Total number of elements required

REFERENCES: DIELEM

ROUTINE NAME: DIEND

DESCRIPTION: This routine outputs final arrays of data (QDS - incident solar, the QDR - incident albedo, and QDP - incident planetary) to the NDI disk file for later reference. It end-files NRTO if a restart tape is desired and end-files NPLS if a PLTYPE (save) flag has been set.

CALLING SEQUENCE: CALL DIEND

REFERENCES: DIMAIN

FILES: Writes the NDI file and closes NPLS and NRTO

ROUTINE NAME: DIENDP

DESCRIPTION: This is a user-callable routine to intervene after completing albedo/planetary computations.

CALLING SEQUENCE: CALL DIENDP

REFERENCES: DIMAIN

ROUTINE NAME: DIENDS

DESCRIPTION: This is a user-callable routine to intervene after completing solar computations.

CALLING SEQUENCE: CALL DIENDS

REFERENCES: DIMAIN

ROUTINE NAME: DIGTST

DESCRIPTION: This routine determines if GN < GT < GX. If true, the function is set equal to 0; if false the value is set equal to 1.

CALLING SEQUENCE: A = DIGTST (GN, GX, GT)

GN - Lower bound
GX - Upper bound
GT - Intermediate value
A - 0, 1 flag

REFERENCES: DISHAD

ROUTINE NAME: DIHEAD

DESCRIPTION: This routine outputs control parameters on request.

CALLING SEQUENCE: CALL DIHEAD

REFERENCES: DIMAIN

ROUTINE NAME: DILOC

DESCRIPTION: This routine computes necessary orbital parameters from input values for PERIOD, TRUEAN, TIMEPR, SUNPV, and various orbital transformations.

CALLING SEQUENCE: CALL DILOC

KEY VARIABLES:

PERIOD	- Orbit period
TRUEAN	- True anomaly
TIMEPR	- Present time
SUNPV	- Sun position vector
PLDC	- Matrix of direction cosines to transform vectors in the planet-oriented VCS to the user-defined VCS

REFERENCES: DIMAIN

FILES:

NOUT	- System output file
NSCR3	- Scratch file

ROUTINE NAME: DILOC2

DESCRIPTION: This routine computes necessary orbital parameters, given the clock and cone angles to the sun and planet.

CALLING SEQUENCE: CALL DILOC2

KEY VARIABLES:

SUNCL	- Sun clock angle
SUNCO	- Sun cone angle
PLCL	- Planet clock angle
PLCO	- Planet cone angle
IORBIT	- Flag for type of orbit

REFERENCES: DILOC

FILES:

NOUT	- System output file
NSCR3	- Scratch file

ROUTINE NAME: DIMAIN

DESCRIPTION: This routine is the main driving logic for computing direct incident fluxes and includes the main computation loops.

CALLING SEQUENCE: CALL DIMAIN

KEY VARIABLES: IN - Sequence to node number currently being computed

REFERENCES: DIPROG (preprocessor-generated)

ROUTINE NAME: DIOUTP

DESCRIPTION: This routine allows the user to change the type or form of printed or punched data. It normally calls:

DIPRTP - To print the albedo/planetary fluxes
DIPNHP - Tp punch the albedo/planetary fluxes
DITPP - To write the albedo/planetary fluxes to the RTO tape in restart format

CALLING SEQUENCE: CALL DIOUTP

REFERENCES: DIMAIN

ROUTINE NAME: DIOUTS

DESCRIPTION: This routine allows the user to change the type or form of printed/punched data. It normally calls:

DIPRTS - To print the solar fluxes
DIPNHS - To punch the solar fluxes
DITPS - To write the solar fluxes to the RTO tape in the restart format

CALLING SEQUENCE: CALL DIOUTS

REFERENCES: DIMAIN

ROUTINE NAME: DIPLNS

DESCRIPTION: This routine computes planet position and area vectors based on the orbit and accuracy parameters, and determines the emissive power of the planet element and view factor from the element to the sun.

CALLING SEQUENCE: CALL DIPLNS (NPEL)

NPEL - Total number of desired elements on planet

KEY VARIABLES:

PLPVT (400, 3)	- Array of planet position vectors
PLAVT (400, 3)	- Array of planet-normal vectors (magnitude = area)
ALBF (400)	- Array of planet-to-sun view factors
PLNF (400)	- Array of planet-element emissive powers

REFERENCES: DICALP

ROUTINE NAME: DIPNHP

DESCRIPTION: This routine punches albedo and planetary fluxes in a format acceptable for restart if the DIPNCH flag has been set to 3HPUN.

CALLING SEQUENCE: CALL DIPNHP

KEY VARIABLES:

DIPNHP	- Flag to determine if punched cards are requested
NODE	- Array of node numbers
QDR	- Array of albedo values
QDP	- Array of planetary values

REFERENCES: DIOUTP

FILES: PUNCH

ROUTINE NAME: DIPNHS

DESCRIPTION: This routine punches solar fluxes in a restart format complete with proper header cards generated on the initial call to the routine.

CALLING SEQUENCE: CALL DIPNHS

KEY VARIABLES: IST - Flag to determine if this is the initial call

REFERENCES: DIOUTS

FILES: PUNCH

ROUTINE NAME: DIPREP

DESCRIPTION: This routine can be replaced by the user prior to computing albedo/planetary fluxes.

CALLING SEQUENCE: CALL DIPREP

REFERENCES: DIMAIN

ROUTINE NAME: DIPRES

DESCRIPTION: This routine can be replaced by the user prior to computing solar fluxes.

CALLING SEQUENCE: CALL DIPRES

REFERENCES: DIMAIN

ROUTINE NAME: DIPROG

DESCRIPTION: This is a preprocessor-generated routine that calls in main driving logic to perform the direct-irradiation computations.

CALLING SEQUENCE: CALL DIPROG

REFERENCES: TRASYS

ROUTINE NAME: DIPRTP

DESCRIPTION: This routine prints albedo/planetary fluxes after each nodal computation. It may be overridden by the user if he desires to change the format.

CALLING SEQUENCE: CALL DIPRTP

KEY VARIABLES: INSHAD - Flag to determine if node is in the planet's shadow
ICRD - Restart card number
IN - Current node sequence number

REFERENCES: DIOUTP

ROUTINE NAME: DIPRTS

DESCRIPTION: This routine prints solar fluxes after each nodal computation. It may be overridden by the user if he desires to change the output format.

CALLING SEQUENCE: CALL DIPRTS

KEY VARIABLES: INSHAD - Flag to determine if node is in the planet's shadow
ICRAO - Restart card number
IN - Current node sequence number

REFERENCES: DIOUTS

ROUTINE NAME: DIPSHP

DESCRIPTION: This routine determines possible shadowing surfaces between Node IN and the planet element.

CALLING SEQUENCE: CALL DIPSHP (RADJ, RADI, POSJ, POSI, NST, JST, IN, JUMP)

RADJ - Radius of sphere enclosing surface node
RADI - Radius of sphere enclosing planet element
POSJ - Position vector of surface sphere
POSI - Position vector of planet element
NST - Number of shadowing surfaces
JST - Number of possible shadowers
IN - Node sequence number being computed
JUMP - Flag for using cylinder or cone technique

KEY VARIABLES: ISHAD - Array of possible shadowers
JST - Number of possible shadowers

REFERENCES: DICALP

ROUTINE NAME: DIPSHS

DESCRIPTION: This routine determines possible shadowing surfaces between Node IN and the sun.

CALLING SEQUENCE: CALL DIPSHS (RADS, POS, SUNP, NSURF, NSHAD, IN)

RADS - Radius of Node IN
POS - Position vector of Node IN
SUNP - Sun position vector
NSURF - Number of shadowing surfaces
NSHAD - Number of possible shadowing surfaces
IN - Sequence number of node being computed

KEY VARIABLES: SHAO - Array of shadowing surfaces

REFERENCES: DICALS

ROUTINE NAME: DIRCOS

DESCRIPTION: This routine computes the direction cosines, given the rotation order and angles.

CALLING SEQUENCE: CALL DIRCOS (II, JJ, KK, PHI, PSI, OMI, TRAN)
II - Defines first rotation
JJ - Defines second rotation
KK - Defines third rotation
PHI - Rotation about Z (Y to X = positive)
PSI - Rotation about Y (X to Z = positive)
OMI - Rotation about X (Y to Z = positive)
TRAN(3,3) - Resultant direction cosine matrix

REFERENCES: ORIENT

ROUTINE NAME: DIRDRQ

DESCRIPTION: This routine defines the restart request arrays and determines the proper initial data based on the compute flags. It also determines if shadowing is computed directly or by a table lookup. If computed, DIRDRQ defines arrays with all-shadowing surface data.

CALLING SEQUENCE: CALL DIRDRQ

KEY VARIABLES:
ISOLFL - Flag for computing, storing, or zeroing the solar fluxes
IALBFL - Flag for computing, storing, or zeroing the albedo fluxes
IPLAFL - Flag for computing, storing, or zeroing the planetary fluxes

REFERENCES: DIMAIN

FILES: NDIR, NDI, NPLS

ROUTINE NAME: DIRPSP

DESCRIPTION: This routine computes the radius, area, and position vector for the planet.

CALLING SEQUENCE: CALL DIRPSP

KEY VARIABLES:
RADP - Radius of the planet
AREAPL - Area of visible portion of planet
POSP(3) - Position vector of planet

REFERENCES: DIMAIN

ROUTINE NAME: DIRTP

DESCRIPTION: This routine reads planet-element factors from a previously stored DI call and defines the QDR and QDP arrays based on known planet factors.

CALLING SEQUENCE: CALL DIRTP

REFERENCES: DITYPE

FILES: NPLS

ROUTINE NAME: DISB

DESCRIPTION: This routine computes the sigma and beta orbit angles, given the right ascension and declination to a star or sun.

CALLING SEQUENCE: CALL DISB (RA, DEC, BET, CIG)

RA - Right ascension angle
DEC - Declination angle
BET - Resultant beta angle
CIG - Resultant sigma angle

REFERENCES: ORBIT1

ROUTINE NAME: DISFTP

DESCRIPTION: This routine loads shadow-factor tables into core from a disk file (NPLS) generated by a prior SFCAL call.

CALLING SEQUENCE: CALL DISFTP

REFERENCES: DIRDRQ

FILES: NPLS

ROUTINE NAME: DISHAD

DESCRIPTION: This routine computes elemental shadowing where all or none is shadowed. If surfaces are transparent, it reduces the shadower by the transmissivity of the surface.

CALLING SEQUENCE: CALL DISHAD (RX, RY, RZ, WE, WA, IN, I, NSS, RS)

RX - Position-vector component of node
RY - Position-vector component of node
RZ - Position-vector component of node
WE - Output IR component of shadowing
$0 \leq WE \leq 1$
WA - Output solar component of shadowing
$0 \leq WA \leq 1$
IN - Surface number containing node involved in shadowing
NSS - Number of possible shadowing surfaces
RS - Distance from center of node to heat source

REFERENCES: DICALS, DICALP

ROUTINE NAME: DITIME

DESCRIPTION: This routine computes the true anomaly from time-dependent orbital characteristics.

CALLING SEQUENCE: CALL DITIME (TIME, PER, ECC, TRU)

```
TIME - Input orbital time
PER  - Orbital period
ECC  - Eccentricity of orbit
TRU  - Output true anomaly
```

REFERENCES: DILOC

ROUTINE NAME: DITPP

DESCRIPTION: This routine outputs albedo/planetary fluxes for a restart from tape if the DIPNCH flag is set to 4HTAPE.

CALLING SEQUENCE: CALL DITPP

KEY VARIABLES: DIPNCH - Flag to determine if restart tape is to be written

REFERENCES: DIOUTP

FILES: NRTO

ROUTINE NAME: DITPS

DESCRIPTION: This routine outputs solar fluxes in a format acceptable for restart into the Flux Data block. If DIPNCH is set to 4HTAPE, it also generates an output tape.

CALLING SEQUENCE: CALL DITPS

REFERENCES: DIOUTS

FILES: NRTO

ROUTINE NAME: DITRS3

DESCRIPTION: This routine converts points from the surface coordinate system to the central coordinate system.

CALLING SEQUENCE: CALL DITRS3 (X, Y, Z, A, B, C, RX, RY, RZ, TRAN)

X, Y, Z - Output translation vector, in CCS
A, B, C - Vector to be transformed
RX, RY, RZ - Vector in CCS
TRAN - Direction cosine matrix

REFERENCES: DIELEM

ROUTINE NAME: DITRS4

DESCRIPTION: This routine converts points in the central coordinate system to the surface coordinate system.

CALLING SEQUENCE: CALL DITRS4 (X, Y, Z, A, B, C, RX, RY, RZ, TRAN)

X, Y, Z - Output converted vector
A, B, C - Input point, in central system
RX, RY, RZ - Translation vector, in SCS
TRAN - Direction cosine matrix

REFERENCES: DILOC, DILOC2

ROUTINE NAME: DITTP

DESCRIPTION: See program listing for definition.

ROUTINE NAME: DITYPE

DESCRIPTION: This routine determines the type of computation and calls the proper routine.

CALLING SEQUENCE: CALL DITYPE

KEY VARIABLES: PLTYPE - Flag indicating that planetary data were previously defined.

REFERENCES: DIMAIN

ROUTINE NAME: DIVWPL

DESCRIPTION: This routine computes elemental planetary factors without shadowing, and forms a sum over all the elements.

CALLING SEQUENCE: CALL DIVWPL

REFERENCES: DICALP

ROUTINE NAME: DIVWSN

DESCRIPTION: This routine computes elemental view factors to be summed without shadowing.

CALLING SEQUENCE: CALL DIVWSN

REFERENCES: DICALS

ROUTINE NAME: DUPNCK

DESCRIPTION: This is a user-called routine in the Operations Data block that determines if a configuration has duplicate node numbers. It aborts if duplicates are found.

CALLING SEQUENCE: CALL DUPNCK

REFERENCES: Operations Data block

ROUTINE NAME: DRCALS

DESCRIPTION: This is the main routine used in calculating the specularly reflected components of incident solar flux.

CALLING SEQUENCE: CALL DRCALS (MIRROR, KN, NSURFS)

MIRROR - Surface sequence number of current specular surface

KN - Index ranging over the number of specular surfaces and indicating the current specular surface

NSURFS - Total number of surfaces, plus images of surfaces, in MIRROR

REFERENCES: DRMAIN

ROUTINE NAME: DRELEM

DESCRIPTION: Given the number of elements in each direction on a node, this routine calculates the area and position vectors for each element.

CALLING SEQUENCE: CALL DRELEM (ILP, DATA, TRAN, RX, RY, RZ, NTOT)

ILP - Surface type
DATA - Nodal dimension parameters (ALPHA, BMIN, BMAX, GMIN, and GMAX)
TRAN - 3 x 3 matrix of direction cosines
RX, RY, RZ - Translation vector
NTOT - Total number of elements required on node

KEY VARIABLES: NEST - Counter for number of elements on a node (maximum allowable = 100)
SFAV - Array of elemental surface area vectors
SFPV - Array of elemental position vectors

REFERENCES: DRCALS

ROUTINE NAME: DRELSL

DESCRIPTION: Given the total number of elements on a node, this routine calculates the number of elements in each direction so as to make them as nearly square as possible.

CALLING SEQUENCE: CALL DRELSL (NB, NG, ILP, DATA, NTOT)

NB - Number of elements in the beta direction
NG - Number of elements in the gamma direction
ILP - Surface type
DATA - Nodal dimension parameters (ALPHA, BMIN, BMAX, GMIN, and GMAX)
NTOT - Minimum number of elements to be distributed over node

REFERENCES: DRELEM

ROUTINE NAME: DREND

DESCRIPTION: This routine writes direct incident fluxes QDS, QDR, and QDP to the NDI disk file (labeled 6HIMAGEQ) to indicate that specular components are included.

CALLING SEQUENCE: CALL DREND

KEY VARIABLES: QDS - Incident solar flux
QDR - Incident albedo flux
QDP - Incident planetary flux

REFERENCES: DRMAIN

FILES: NDI - Disk file for storing direct incident fluxes

ROUTINE NAME: DRENDS

DESCRIPTION: This is a user routine that enables the user to intervene after calculating the incident solar fluxes.

CALLING SEQUENCE: CALL DRENDS

REFERENCES: DRMAIN

ROUTINE NAME: DRGTST

DESCRIPTION: This is an integer function routine that tests a given value, GT, to determine if it falls in the range GN<GT<GX. If true, the function value is 0 (zero); if false, the function value is 1 (one).

CALLING SEQUENCE: DRGTST (GN, GX, GT)

GN - Lower bound
GX - Upper bound
GT - Value to be tested

REFERENCES: DRSHAD

DRIMAG

DESCRIPTION: This routine images the solar vector, as well as all shadowing surfaces, and writes the results on scratch file NSCR2 for each specular surface.

CALLING SEQUENCE: CALL DRIMAG (NST)

NST - Number of active surfaces
NSURFS - Number of active surfaces plus number of images in any given specular surface
IFS, IKS, PR, DSTR, DIMS, PSH, TSTR - Shadowing surface description parameters
SUNPVT - Solar vector

REFERENCES: DRMAIN

FILES: NSCR2 - Scratch file

ROUTINE NAME: DRMAIN

DESCRIPTION: This routine contains the main driving logic for computing direct incident fluxes, including specular components.

CALLING SEQUENCE: CALL DRMAIN

KEY VARIABLES: ISPEC - Array of surface sequence numbers for specular surfaces
SUNPVT - Solar vector
PLDC - Matrix of direction cosines to transform vectors in the planet-oriented VCS to the user-defined VCS

REFERENCES: DRPROG

FILES: NRAN - Random access file
NSCR2 - Scratch file
NSCR3 - Scratch file

ROUTINE NAME: DROUTP

DESCRIPTION: This is a user routine that can be replaced to change the form of output for albedo and planetary incident fluxes. The normal call is to DRPRTP, which prints the albedo and planetary fluxes.

CALLING SEQUENCE: CALL DROUTP

REFERENCES: DRMAIN

ROUTINE NAME: DROUTS

DESCRIPTION: This is a user routine that can be replaced to change the form of output for incident solar fluxes. The normal call is to DRPRTS, which prints the solar fluxes.

CALLING SEQUENCE: CALL DROUTS

REFERENCES: DRMAIN

ROUTINE NAME: DRPOSI

DESCRIPTION: This routine transforms a vector in the ICS, BCS, or CCS to a vector in the SCS of a specular surface, negates the Z component, and transforms it back into the ISC, BCS, or CCS.

CALLING SEQUENCE: CALL DRPOSI (X, Y, Z, TRAN)

X, Y, Z - Vector components in ICS, BCS, or CCS
TRAN - Matrix of direction cosines

KEY VARIABLES: A, B, C - Vector components in the SCS

REFERENCES: DRIMAG

ROUTINE NAME: DRPRTP

DESCRIPTION: This routine prints albedo and planetary incident fluxes after each nodal computation. The user can override this routine to change the output format if he desires.

CALLING SEQUENCE: CALL DRPRTP

KEY VARIABLES: IN - Current node sequence number
INSHAD - Flag to indicate if vehicle is in planet shadow

REFERENCES: DROUTP

FILES: NOUT - System output file

ROUTINE NAME: DRPRTS

DESCRIPTION: This routine prints the solar incident flux after each nodal computation. The user can override this routine to change the output format if he desires.

CALLING SEQUENCE: CALL DRPRTS

KEY VARIABLES: IN - Current node sequence number
INSHAD - Flag to indicate if vehicle is in planet shadow

REFERENCES: DROUTS

FILES: NOUT - System output file

ROUTINE NAME: DRPSHS

DESCRIPTION: This routine determines all possible shadowing surfaces between Node IN and the image of the sun in specular surface MIRROR.

CALLING SEQUENCE: CALL DRPSHS (RADS, POS, SUNP, NSURF, NSS, NSHAD, IN, MIRROR)

RADS - Radius of sphere enclosing Node IN
POS - Position vector of enclosing sphere
SUNP - Image of solar vector in specular surface MIRROR
NSURF - Total number of shadowing surfaces
NSS - Total number of shadowing surfaces plus images of shadowing surfaces in MIRROR
NSHAD - Number of possible shadowing surfaces
IN - Sequence number of current node
MIRROR - Surface sequence number of current specular surface

REFERENCES: DRCALS

ROUTINE NAME: DRRDRQ

DESCRIPTION: This routine initializes the direct incident flux arrays QDS, QDR, and QDP to the flux values calculated by segment DICAL.

CALLING SEQUENCE: CALL DRRDRQ

KEY VARIABLES: QDS - Incident solar flux array
QDR - Incident albedo flux array
QDP - Indicent planetary flux array

REFERENCES: DRMAIN

FILES: NOUT - System output file
NDI - Disk file for storing direct incident fluxes

ROUTINE NAME: <u>DRSHAD</u>

DESCRIPTION: This routine calculates the elemental shadowing, where an element is either completely shadowed or not shadowed at all. Shadowing is reduced by the transmissivity for semitransparent shadowing surfaces.

CALLING SEQUENCE: CALL DRSHAD (RX, RY, RZ, WE, WA, IN, I, NSS, RS, MIRROR)

RX, RY, RZ	- Components of solar position vector
WE, WA	- Elemental shadowing factors for IR and solar fluxes
IN	- Surface sequence number
I	- Sequence number of element
NSS	- Number of possible shadowing surfaces
RS	- Square of the magnitude of the solar vector
MIRROR	- Sequence number of current specular surface

REFERENCES: DRCALS

ROUTINE NAME: <u>DRTRS3</u>

DESCRIPTION: This routine transforms points in an SCS to points in the ICS, BCS, or CCS.

CALLING SEQUENCE: CALL DRTRS3 (X, Y, Z, A, B, C, RX, RY, RZ, TRAN)

X, Y, Z	- Coordinates of a point in the ICS, BCS or CCS
A, B, C	- Coordinates of the point in the SCS
RX, RY, RZ	- Components of the SCS origin position vector in the ICS, BCS, or CCS
TRAN	- Matrix of direction cosines

REFERENCES: DRELEM, DRIMAG

ROUTINE NAME: DRTRS4

DESCRIPTION: This routine transforms points in the ICS, BCS, or CCS to points in an SCS.

CALLING SEQUENCE: CALL DRTRS4 (X, Y, Z, A, B, C, RX, RY, RZ, TRAN)

X, Y, Z - Coordinates of a point in the SCS
A, B, C - Coordinates of the point in the ICS, BCS, or CCS
RX, RY, RZ - Components of the ICS, BCS, or CCS origin position vector in the SCS
TRAN - Matrix of direction cosines

REFERENCES: DRIMAG

ROUTINE NAME: DRVWSN

DESCRIPTION: This routine calculates the unshadowed form factor from a node to the sun.

CALLING SEQUENCE: CALL DRVWSN (AREASF, NOT, FRACT)

AREASF - Surface area of current node
NOT - Flag to indicate whether node can "see" the sun
= 0 Can see
= 1 Cannot see
FRACT - Unshadowed node-to-sun form factor

REFERENCES: DRCALS

ROUTINE NAME: EARTHD

DESCRIPTION: This routine defines all Earth-oriented constants needed by the DI link.

CALLING SEQUENCE: CALL EARTHD

REFERENCES: ORBIT1, ORBIT2

ROUTINE NAME: ENDTP

DESCRIPTION: This routine writes a pseudo end file on the BCD unit and informs the user as to type of data the unit contains.

CALLING SEQUENCE: CALL ENDTP (NTYPE)

NTYPE - Flag to indicate type of end message to write

REFERENCES: RKMAIN, QOSAVE

ROUTINE NAME: FFAREA

DESCRIPTION: This routine computes the area of a surface, given the surface properties.

CALLING SEQUENCE: FUNCTION FFAREA (ILP, ALPH, BMIN, BMAX, GMIN, GMAX)

ILP - Surface type
ALPH, BMIN, BMAX, GMIN, GMAX - Surface dimensions

REFERENCES: FFEXPN

ROUTINE NAME: FFCAL

DESCRIPTION: This is the main computation routine for computing the form factor. It determines the proper number of elements and computes position area vectors and the final form factor, including shadowing.

CALLING SEQUENCE: CALL FFCAL

REFERENCES: FFPRE

ROUTINE NAME: FFDATA

DESCRIPTION: This is a user-callable routine to define the control variables in the FF link.

CALLING SEQUENCE: CALL FFDATA (ACC, ACCS, RNOSH, RATL, RMIN, PRNT, PNCH)

See Users Manual, Appendix D, for definition

REFERENCES: Operations Data block

ROUTINE NAME: FFELEM

DESCRIPTION: This routine computes elemental position and area vectors, given the number required in each nodal direction.

CALLING SEQUENCE: CALL FFELEM (NB, NG, ILP, IC, DATA, POS, ARA, TRAN, RX, RY, RZ)

NB	- Number of elements in the beta direction
NG	- Number of elements in the gama direction
ILP	- Surface type
IC	- Position to start storing element in the POS and ARA arrays
DATA(5)	- Array of node dimensions
POS(500, 3)	- Array of element position vectors
ARA(500, 3)	- Array of normal vectors (magnitude & area)
TRAN(3, 3)	- Direction cosine matrix of node
RX, RY, RZ	- Position vector of center of node

REFERENCES: FFCAL, FFEXPN

ROUTINE NAME: FFELSL

DESCRIPTION: This routine uses the total number of elements on a node to compute the number of elements in various directions so that the elements are square.

CALLING SEQUENCE: CALL FFELSL (NB, NG, ILP, DATA, NTOT)

NB - Computed number of elements in the beta direction
NG - Computed number of elements in the gamma direction
ILP - Surface type
DATA(S) - Array of surface dimensions
NTOT - Total number of elements to subdivide the node into

REFERENCES: FFCAL, FFEXPN

ROUTINE NAME: FFEND

DESCRIPTION: This routine is called prior to the termination of the FF link to write the end-of-files to the internal disk units and restart files.

CALLING SEQUENCE: CALL FFEND

REFERENCES: FFMAIN

FILES: NFF, NRTO

ROUTINE NAME: FFESUM

DESCRIPTION: This routine outputs form-factor sums for all nodes.

CALLING SEQUENCE: CALL FFESUM

KEY VARIABLES: SUM - Array of form-factor sums

REFERENCES: FFEND

ROUTINE NAME: FFEXPN

DESCRIPTION: This routine computes a node-pair form factor with shadowing, using the subnode technique. Logic is entered when the separation distance along the node varies by more than FFRATL.

CALLING SEQUENCE: CALL FFEXPN (POSI, ARAI, FE, FA, RATI, RATJ, JFLAG, JST, NEI, NEJ, NSUR, IADDR)

POSI - Position vector, storing elements on node i and j
ARAI - Area vector, storing elements on node i and j
FE - Resultant IR form factor
FA - Resultant solar form factor
RATI - Ratio of rate of change along node i
RATJ - Ratio of rate of change along node j
JFLAG - Flag indicating that maximum number of elements has been exceeded
JST - Number of possible shadowers
NEI - Average number of elements on node i
NEJ - Average number of elements on node j
NSUR - Average number of shadowing surfaces
IADDR - Maximum time return sequence (not used)

REFERENCES: FFCAL

ROUTINE NAME: FFGTST

DESCRIPTION: This routine determines if gamma falls in allowable ranges and sets the functional value to 1 if it does and to 0 if it doesn't.

CALLING SEQUENCE: FFGTST (GN, GX, GT)

GN - Minimum gamma
GX - Maximum gamma
GT - Gamma in question

REFERENCES FFSHD

ROUTINE NAME: FFHEAD

DESCRIPTION: This routine prints FF control values in summary form on an output file.

CALLING SEQUENCE: CALL FFHEAD

REFERENCES: FFMAIN

ROUTINE NAME: FFMAIN

DESCRIPTION: This is the main controlling logic in the FF link. It checks for restart data and directs the logic flow.

CALLING SEQUENCE: CALL FFMAIN

REFERENCES: FFPROG

ROUTINE NAME: FFMINR

DESCRIPTION: This routine determines if the computed form factor is less than the control value FFMIN. If less, it redefines the FFVALS and FFVALI array elements to zero.

CALLING SEQUENCE: CALL FFMINR

REFERENCES: FFOUT

ROUTINE NAME: FFOUT

DESCRIPTION: This is a user-replaceable routine calling for print (as a minimum) and punch options.

CALLING SEQUENCE: CALL FFOUT

REFERENCES: FFMAIN

ROUTINE NAME: FFPCH

DESCRIPTION: This routine punches restart form factors if the FFPNCH option is used. The restart form factors are punched in a format acceptable to the Header Form Factor Data block.

CALLING SEQUENCE: CALL FFPCH

REFERENCES: FFOUT

ROUTINE NAME: FFPRE

DESCRIPTION: This is a user-definable routine to determine the type of computation. The program normally calls FFCAL to use a finite-element technique.

CALLING SEQUENCE: CALL FFPRE

REFERENCES: FFMAIN

ROUTINE NAME: FFPROG

DESCRIPTION: This is a preprocessor-generated routine that defines necessary common blocks and calls into the main logic.

CALLING SEQUENCE: CALL FFPROG

REFERENCES: TRASYS (root segment)

ROUTINE NAME: FFPRT

DESCRIPTION: This routine prints nonzero computed and predefined form factors on an output file.

CALLING SEQUENCE: CALL FFPRT

REFERENCES: FFOUT

ROUTINE NAME: FFPSHD

DESCRIPTION: This routine computes the number of possible shadowing surfaces between node pairs.

CALLING SEQUENCE: CALL FFPSHD (RADJ, RADI, POSJ, POSI, NST, JST, IN, JN)

RADJ - Radius of sphere enclosing node j
RADI - Radius of sphere enclosing node i
POSI - Position vector to center of sphere enclosing node i
POSJ - Position vector to center of sphere enclosing node i
NST - Number of shadowing surfaces
JST - Number of possible shadowers
IN - Sequence numbers of node i
JN - Sequence numbers of node j

REFERENCES: FFCAL, FFEXPN

ROUTINE NAME: FFRDIN

DESCRIPTION: This routine determines if there is a form factor restart, and defines the shadowing data.

CALLING SEQUENCE: CALL FFRDIN (ISHDO)

ISHDO - Flag indicating shadower-only surfaces
1 - Shadower-only surfaces
0 - Not shadower-only surfaces

REFERENCES: FFMAIN

ROUTINE NAME: FFRDRQ

DESCRIPTION: This routine reads the restart file of form factors and defines known values, or sets a flag to compute values for the current row.

CALLING SEQUENCE: CALL FFRDRQ

IEOFFR - End-of-file flag for the NFFR unit
FFVALI - Array of values/flags to compute IR
FFVALS - Array of values/flags to compute solar

REFERENCES: FFMAIN

FILES: NFFR - Read

ROUTINE NAME: FFROW

DESCRIPTION: This routine outputs to internal file NFF a row of form factors to be used in matrix form by other links.

CALLING SEQUENCE: CALL FFROW

REFERENCES: FFMAIN

FILES: Writes NFF

ROUTINE NAME: FFRPSN

DESCRIPTION: Given the nodal dimensions, this routine computes the radius of an encompassing sphere and the position vector to the center of the sphere.

CALLING SEQUENCE: CALL FFRPSN (RADN, POSN, ILK, DATA, BETA, GAMMA, DB, DG)

RADN - Computed radius of sphere enclosing node
POSN(3) - Vector to center of node
ILK - Surface type
DATA(S) - Dimensions of sphere
BETA - Length to center along beta direction
GAMMA - Length to center along gamma direction
DB - Absolute value of deviation from gamma
DG - Absolute value of deviation from beta

REFERENCES: FFEXPN

ROUTINE NAME: FFRSUM

DESCRIPTION: This routine is called after completing each row, to output the FF sum and time.

CALLING SEQUENCE: CALL FFRSUM

REFERENCES: FFROW

ROUTINE NAME: FFSHD

DESCRIPTION: This routine computes elemental shadowing between node IN and node JN. An element is either completely shadowed or not shadowed at all. Shadowing is reduced by the transmissivity for semitransparent shadowing surfaces.

CALLING SEQUENCE: CALL FFSHD (ILKI, RX, RY, RZ, POSI, WE, WA, IST, IN, JN, I, NSS, RS)

ILKI – Type of surface for IN
RX, RY, RZ – Components of vector from element on node i to element on node j
POSI – Array of elemental position vectors
WE, WA – Elemental shadowing factors for IR and solar form factors
IN, JN – Surface sequence numbers
I – Element sequence number
NSS – Number of possible shadowers
RS – Square of the magnitude of the element-to-element connecting vector(RX^2 + RY^2 + RZ^2)

REFERENCES: FFCAL, FFEXPN

ROUTINE NAME: FFTMCK

DESCRIPTION: This routine calculates the time remaining in the run and compares it with the estimated time for the next calculation. It there is insufficient time remaining, the run is aborted.

CALLING SEQUENCE: CALL FFTMCK (IADDR, MAXLFT)

IADDR – Not used
MAXLET – Estimated time required for next calculation

M – Time remaining in run

REFERENCES: FFCAL, FFEXPN

ROUTINE NAME: FFTP

DESCRIPTION: This routine uses the CMERG (BCD) file to write to the restart output tape single form factors in a form acceptable to Header Form Factor Data block. It also checks the FFPNCH flag and returns if the value is not 4HTAPE.

CALLING SEQUENCE: CALL FFTP

REFERENCES: FFOUT

ROUTINE NAME: FFTRS3

DESCRIPTION: This routine transforms a point in an SCS to points in the ICS, BCS, and CCS.

CALLING SEQUENCE: CALL FFTRS3 (X, Y, Z, A, B, C, RX, RY, RZ, TRAN)

X, Y, Z - Coordinates of a point in the ICS, BCS, or CCS

A, B, C - Coordinates of the point in the SCS

RX, RY, RZ - Components of the SCS origin position vector in the ICS, BCS, or CCS

TRAN - Matrix of direction cosines

REFERENCES: FFELEM

ROUTINE NAME: FFVIEW

DESCRIPTION: This routine calculates the unshadowed form factor between node IN and node JN. It also calculates RATI and RATJ, which will later be compared with the user-input variable, FFRATL, to see if nodes should be expanded into subnodes for better accuracy.

CALLING SEQUENCE: CALL FFVIEW (NTI, NTJ, POSI, ARAI, NTOTI, NTOTJ, ARI, ARJ, NOT, FRACT, RATI, RATJ)

NTI	- Initial number of elements on node IN
NTJ	- Total initial number of elements on node IN and node JN
POSI	- Array of elemental position vector
ARAI	- Array of elemental area vectors
NTOTI, NTOTJ	- Number of elements required on node IN and node JN
ARI, ARJ	- Areas of node IN and node JN
NOT	- Flag to indicate whether node IN can see node JN = 0 Can see = 1 Cannot see
FRACT	- Unshadowed node-to-node form factor
RATI, RATJ	- Ratios of indicated maximum elements required in NTOTI and NTOTJ

REFERENCES: FFCAL

ROUTINE NAME: FFVWT

DESCRIPTION: This routine calculates unshadowed form factors between subnodes and determines the number of elements required based on a weighted-average criterion.

CALL FFVWT (NTI, NTJ, POSI, ARAI, NTOTI, NTOTJ, ARI, ARJ, NTOTI, NTOTJ, FRACT)

NTI - Number of elements on subnode of node IN

NTJ - Total number of elements on subnode IN and subnode JN

POSI - Array of elemental position vectors

ARAI - Array of elemental area vectors

NTOTI, NTOTJ - Number of elements required on subnodes of node IN and node JN

ARI, ARJ - Areas of subnodes

NOT - Flag to indicate whether subnode IN can "see" subnode IN

= 0 Can see

= 1 Cannot see

FRACT - Unshadowed subnode-to-subnode form factor

REFERENCES: FFEXPN

ROUTINE NAME: FINDST

DESCRIPTION: Given the unit, step number, label 1, and label 2, this routine positions the file at the proper point or returns an end-of-file flag indicating it was unable to find the data.

CALLING SEQUENCE: CALL FINDST (NUNIT, ISTEP, LAB1, LAB2, IEOF)

NUNIT - Unit to be searched

ISTEP - Program step number needed

LAB1 - Subidentifier 1

LAB2 - Subidentifier 2

IEOF - Flag indicating if data were found

= 2HNO, No end-of-file encountered (found data)

= 3HYES End-of-file found (no data)

REFERENCES: FFRDIN, SFMAIN, SFRDIN, DIRDRQ, GBMAIN, RKMAIN, AQMAIN, QOMAIN, QOCMBN, PLLOAD, FNDFLP, RCMAIN

FILES: All internal data files

ROUTINE NAME: FLIP

DESCRIPTION: Given a working storage area, this routine flips a matrix in row order on unit NS1 to a matrix in column order and writes it to unit NS2.

CALLING SEQUENCE: CALL FLIP (DATA, NV, NTIME, ICOL, NS1, NS2)

```
DATA  - Working storage area
NV    - Number of rows stored at one time
NTIME - Number of rows
ICOL  - Number of columns
NS1   - Unit containing the input matrix
NS2   - Unit containing the output matrix
```

REFERENCES: FNDFLP

ROUTINE NAME: FNDEXP

DESCRIPTION: Given a floating-point number, this routine converts it to scientific notation.

CALLING SEQUENCE: CALL FNDEXP (X, BASE, IEXP)

X - Floating-point variable
BASE - $0.0 \le \text{BASE} \le 1.0$
IEXP - Exponent such that X = BASE**IEXP

REFERENCES: QOSBCD, QOAVGS

ROUTINE NAME: FNDFLP

DESCRIPTION: This routine reads the overall incident solar, albedo, planetary, and total fluxes from a disk generated by AQCAL or DICAL and stores them on a scratch file by sequential orbit points. It also builds titles as a function of user input data.

CALLING SEQUENCE: CALL FNDFLP (DATA, SOL, ALB, PLA, TOT, NV, LC1, LC2, LC3, NTIME, ITIME, TIME, NUNIT)

DATA - Working storage area where DATA (1) = SOL (1)
SOL - Working array DATA (NTIME+1) = ALB(1)
ALB - Working array DATA (2NTIME+1) = PLA(1)
PLA - Working array DATA (3NTIME+1) = TOT(1)
TOT - Working array
NV -
LC1 - First control character - I (incident) or A (absorbed)
LC2 - Second control character - F (flux) or R (rate)
LC3 - Third control character - S (solar), A (albedo), P (planetary), T (total) and ALL (all)
NTIME - Number of orbit positions
ITIME, TIME - Doublet array containing time and step number
NUNIT - Plot output unit

REFERENCES: PLLOAD

FILES: NSCR1, NSCR2

ROUTINE NAME: FRAME

DESCRIPTION: This is a plotting routine to advance to a new frame.

CALLING SEQUENCE: CALL FRAME

REFERENCES: NPMAIN, OPMAIN, PLDRIV

ROUTINE NAME: FRAMEC

DESCRIPTION: This routine determines the number of frames of plot data generatcd to this point.

CALLING SEQUENCE: CALL FRAMEC (N, I)

```
N - Number of frames
I - Dayfile message flag
    = 0 Do not print dayfile message
    = 1 Print dayfile message
```

REFERENCES: NPMAIN, OPMAIN

ROUTINE NAME: GBDATA

DESCRIPTION: This is a user-called routine to define the step number and type of gray-bodies to compute.

CALLING SEQUENCE: CALL GBDATA (NSFF, NBAND)

```
NSFF  - Step number containing form factors
WBAND - Waveband to compute gray-bodies for
        2HIR, 3HSOL, and 4HBOTH
```

REFERENCES: Operations Data block

ROUTINE NAME: GBEND

DESCRIPTION: This routine can be replaced by the user to intervene after completion of the gray-body link.

CALLING SEQUENCE: CALL GBEND

REFERENCES: GBMAIN

ROUTINE NAME: GBHEAD

DESCRIPTION: This routine prints the input parameters defined by the user, together with input options.

CALLING SEQUENCE: CALL GBHEAD

REFERENCES: GBMAIN

ROUTINE NAME: GBINV

DESCRIPTION: This routine computes the inverse of the matrix stored in core or in large blocks on disk.

CALLING SEQUENCE: CALL GBINV (A, B)

A - Working block 1
B - Working block 2

REFERENCES: GBSCFA

ROUTINE NAME: GBMAIN

DESCRIPTION: This is the main controlling routine in the gray-body link that directs main control and defines the block size.

CALLING SEQUENCE: CALL GBMAIN

REFERENCES: GBPROG

ROUTINE NAME: GBPRE

DESCRIPTION: This routine can be replaced by the user to intervene prior to the call to the invert routine.

CALLING SEQUENCE: CALL GBPRE

REFERENCES: GBMAIN

ROUTINE NAME: GBPROG

DESCRIPTION: This is a preprocessor-generated routine that defines the necessary commons and calls into the main gray-body logic.

CALLING SEQUENCE: CALL GBPROG

REFERENCES: TRASYS (root segment)

ROUTINE NAME: GBSCFA

DESCRIPTION: Given the set of form factors, this routine blocks the matrix and applies the proper factors to generate a positive definite matrix, and guarantees that the inverse exists.

CALLING SEQUENCE: CALL GBSCFA

REFERENCES: GBMAIN

FILES: Reads NFF, writes NSCR1

ROUTINE NAME: IACT

DESCRIPTION: This routine returns the number of elements in an array defined in the array data block. The integer count of the array is stored in the zeroth cell of the array.

CALLING SEQUENCE: Function IACT (IA)

IA - First data word of array

REFERENCES: NPDATA, OPDATA

ROUTINE NAME: INIT28

DESCRIPTION: This routine initializes the plot link and sets up the plot file.

CALLING SEQUENCE: CALL INIT28

REFERENCES: PLMAIN, NPMAIN, OPMAIN

ROUTINE NAME: INTOD

DESCRIPTION: This routine sets up the NTITLE array used in page headings and is called each time the operations data are called after a link call.

CALLING SEQUENCE: CALL INTOD

REFERENCES: OPPROG (generated by preprocessor)

ROUTINE NAME: JUPIDD

DESCRIPTION: This routine sets up the planet parameters concerning the planet Jupiter.

CALLING SEQUENCE: CALL JUPIDD

KEY VARIABLES:

PRAD	- Planet radius
SOL	- Solar constant
PALB	- Planet albedo factor
WDS	- Planet darkside temperature
WSS	- Planet sun side temperature
GRAV	- Gravitational constant

REFERENCES: ORBIT1, ORBIT2

ROUTINE NAME: LINE

DESCRIPTION: This routine connects the points P_1 and P_2 defined by $P_1 = (X_1, Y_1)$, $P_2 = (X_2, Y_2)$

CALLING SEQUENCE: CALL LINE (X1, Y1, X2, Y2)

X1, Y1 - Coordinates of point 1
X2, Y2 - Coordinates of point 2

REFERENCES: NPFPLT, OPFPLT, PLGRID

ROUTINE NAME: LINEOP

DESCRIPTION: This routine defines the intensity of the lines drawn by the plot routines.

CALLING SEQUENCE: CALL LINEOP (DUM, INTEN)

```
DUM   - Dummy parameter
INTEN - Variable defining intensity
```

REFERENCES: NPSCAL, OPSCAL

ROUTINE NAME: LINES

DESCRIPTION: This routine connects the arrays of X and Y with a line.

CALLING SEQUENCE: CALL LINES (X, Y, N)

```
X - Array of X
Y - Array of Y
N - Number of points in X and Y arrays
```

REFERENCES: PLDRIV

ROUTINE NAME: MAP

DESCRIPTION: This routine maps the plot object space into subject space.

CALLING SEQUENCE: CALL MAP (XMIN, YMIN, XMAX, YMAX, XMI, XMA, YMI, YMA)

```
XMIN, YMIN, XMAX, YMAX - Corner points of object space
XMI, XMA, YMI, YMA     - New corner points of subject
                         space
```

REFERENCES: NPSCAL, NPINFO, OPSCAL, OPINFO, PLGRID

ROUTINE NAME: MARSD

DESCRIPTION: This routine defines the planet parameters concerning the planet Mars.

CALLING SEQUENCE: CALL MARSD

KEY VARIABLES:

PRAD	- Planet radius
SOL	- Solar Constant
PALB	- Planet albedo factor
WDS	- Planet darkside temperature
WSS	- Planet sun side temperature
GRAV	- Gravitational constant

REFERENCES: ORBIT1, ORBIT2

ROUTINE NAME: MERCUD

DESCRIPTION: This routine sets up the planet parameters concerning the planet Mercury.

CALLING SEQUENCE: CALL MERCUD

KEY VARIABLES:

PRAD	- Planet radius
SOL	- Solar constant
PALB	- Planet albedo factor
WDS	- Darkside temperature
WSS	- Sun side temperature
GRAV	- Gravitational constant

REFERENCES: ORBIT1, ORBIT2

ROUTINE NAME: MOOND

DESCRIPTION: This routine defines the planet parameters concerning the Moon.

CALLING SEQUENCE: CALL MOOND

KEY VARIABLES:

PRAD	- Planet radius
SOL	- Solar constant
PALB	- Albedo factor
WDS	- Darkside temperature
WSS	- Sun side temperature
GRAV	- Gravitational constant

REFERENCES: ORBIT1, ORBIT2

ROUTINE NAME: NDATA

DESCRIPTION: This is a user routine to preset the node plot optional parameters.

CALLING SEQUENCE: CALL NDATA (NV, IVU, SCL, ISELN, ITIT, NPHI, NPSI, NOMI, PHI, PSI, OMI)

KEY VARIABLES: See users manual Appendix D.

REFERENCES: User-defined call in the Operations Data block

ROUTINE NAME: NDATAS

DESCRIPTION: This routine is the short-form, user-callable routine to define the node plotter options the user wishes to use.

CALLING SEQUENCE: CALL NDATAS (NV, IVU, SCL)

NV - Plot frame number ($1 \leq NV \leq 6$)
IVU - Plot view type (X, Y, Z, 3-D gen)
SU - Plot scale number

REFERENCES: User-called in the Operations Data block.

ROUTINE NAME: NEPTD

DESCRIPTION: This routine defines the planet parameters concerning the planet Neptune.

CALLING SEQUENCE: CALL NEPTD

KEY VARIABLES: PRAD - Planet radius
SOL - Solar constant
PALB - Planet albedo factor
WDS - Darkside temperature
WSS - Sun side temperature
GRAV - Gravitational constant

REFERENCES: ORBIT1, ORBIT2

ROUTINE NAME: NPAXES

DESCRIPTION: This routine defines the size and orientation of all characters to be small and horizonal, and draws and labels the CCS axes.

CALLING SEQUENCE: CALL NPAXES

KEY VARIABLES: VROT (3, 3) - Direction cosine matrix converting points in the SCS to the CCS

REFERENCES: NPMAIN

ROUTINE NAME: NPCONE

DESCRIPTION: This routine, given the surface/node dimensions in the SCS generates the portion of the cone defined, converts it to the CCS, and plots the results.

CALLING SEQUENCE: CALL NPCONE

REFERENCES: NPMAIN

ROUTINE NAME: NPCONV

DESCRIPTION: This routine converts the plot control data from common and checks for errors. If no data are defined in common, it sets up the proper default parameters.

CALLING SEQUENCE: CALL NPCONV (NV, NNP, NEND)

NV - Plot view frame number
NNP - Number of nodes to be selectively plotted
NEND - End flag determining if more plots are needed

REFERENCES: NPMAIN

ROUTINE NAME: NPCYLO

DESCRIPTION: This routine, given the surface/node dimensions in the SCS, determines the proper plot calls to draw a cylinder.

CALLING SEQUENCE: CALL NPCYLO

REFERENCES: NPMAIN

ROUTINE NAME: NPDISC

DESCRIPTION: This routine, given the surface/node dimensions in the SCS, determines the proper plot calls to draw a disk.

CALLING SEQUENCE: CALL NPDISC

REFERENCES: NPMAIN

ROUTINE NAME: NPDOTL

DESCRIPTION: This routine connects P1 and P2 with a dotted line.

CALLING SEQUENCE: CALL NPDOTL (X1, Y1, Z1, X2, Y2, Z2)

X1, Y1, Z1 - Coordinates of P1
X2, Y2, Z2 - Coordinates of P2

REFERENCES: NPCONE, NPCYLO, NPPARA, NPSPHE

ROUTINE NAME: NPFPLT

DESCRIPTION: This routine directs the actions of the pen/beam plotter. I is either even or odd, or negative or positive.

CALLING SEQUENCE: CALL NPFPLT (I, X, Y)

I - Plotting designator
- Even, [Draw to (X, Y)]
O - Odd, [Position at (X, Y)]
- Positive, (generates new origin)
- Negative, (keeps same origin)
X, Y - Coordinates of new point

REFERENCES: NPAXES, NPCONE, NPCYLO, NPDOTL, NPTPLT, NPDISC, NPPARA, NPRECT, NPSPHE, NPTRAP

ROUTINE NAME: <u>NPINFO</u>

DESCRIPTION: This routine labels the plot.

CALLING SEQUENCE: CALL NPINFO (NV, KEND, KCC)

NV - View number
KEND - = 0 Good plot
≠ 0 Error in plot
KCC - Internal view number

REFERENCES: NPMAIN

ROUTINE NAME: NPMAIN

DESCRIPTION: This routine is the main driving logic to control the node plot link.

CALLING SEQUENCE: CALL NPMAIN

REFERENCES: NPPROG (preprocessor-generated)

ROUTINE NAME: NPPARA

DESCRIPTION: This routine, given the node dimensions in the SCS, generates the plot calls necessary to draw a paraboloid.

CALLING SEQUENCE: CALL NPPARA

REFERENCES: NPMAIN

ROUTINE NAME: NPPROG

DESCRIPTION: This routine is generated by the preprocessor. It defines the necessary labeled common blocks and calls into the main driving logic for the node plotter.

CALLING SEQUENCE: CALL NPMAIN

REFERENCES: TRASYS (root segment)

ROUTINE NAME: NPRECT

DESCRIPTION: This routine, given the nodal dimensions, generates the plot calls to draw a rectangle.

CALLING SEQUENCE: CALL NPRECT

REFERENCES: NPMAIN

ROUTINE NAME: NPRIDA

DESCRIPTION: This routine is unique to the Univac version, and defines a system-labeled common block with a user name and location for labeling the plots. An initialization routine is called from this routine to initialize the plot.

CALLING SEQUENCE: CALL NPRIDA (IARRAY)

```
IARRAY (1) - Name (word 1)
IARRAY (2) - Name (word 2)
IARRAY (3) - User mail number
IARRAY (4) - Extension
IARRAY (5) - Blank
IARRAY (6) - Project
```

REFERENCES: User-callable routine from the Operations Data block

ROUTINE NAME: NPRIDS

DESCRIPTION: This routine is unique to the Univac version and is used to define the plots so they contain a name, mail address, project, and extension by defining a system-labeled common.

CALLING SEQUENCE: CALL NPRIDS (NAME1, NAME2, IBOX, IEXT, IPROJ)

```
NAME1, NAME2 - User name (2 words)
IBOX         - Mail address
IEXT         - Telephone extension
IPROJ        - User project number
```

REFERENCES: User-callable routine in the Operations Data block

ROUTINE NAME: NPRNT

DESCRIPTION: This routine prints a summary of node information as the configuration is generated by routines BUILDC/ADD.

CALLING SEQUENCE: CALL NPRNT (NRMASS, NAME)

NRMASS - Array of node data
NAME - Block coordinate system name

REFERENCES: BUILDC, ADD

ROUTINE NAME: NPROTA

DESCRIPTION: This routine defines the transformation of the direction cosine matrix, given the desired view.

CALLING SEQUENCE: CALL NPROTA

KEY VARIABLES: KC - Desired view number
PH, PS, OM - Angles necessary to arrive at desired view

REFERENCES: NPMAIN

ROUTINE NAME: NPSCAL

DESCRIPTION: This routine determines the grid subject space, maps into the new space, and locates the pen/beam at the new origin.

CALLING SEQUENCE: CALL NPSCAL (XS, YS, X, Y)

XS - Scale factor
YS - Scale factor
X - 0.0
Y - 0.0

REFERENCES: NPAXES

ROUTINE NAME: NPSPHE

DESCRIPTION: This routine, given the nodal dimensions, generates the plot calls necessary to draw a sphere or segment of a sphere.

CALLING SEQUENCE: CALL NPSPHE

REFERENCES: NPMAIN

ROUTINE NAME: NPTPLT

DESCRIPTION: This routine transforms a point in 3-D space to X, Y coordinates in the subject space, checks to determine if they are in the allowable range, and moves the pen/beam to the coordinates of that point.

CALLING SEQUENCE: CALL NPTPLT (I, XP, YP, X3, Y3, Z3)

I	- Pen-up, pen-down flag
XP, YP	- Coordinates of transformed point
X3, Y3, Z3	- Coordinates of input point

REFERENCES: NPCONE, NPCYLO, NPDISC, NPPARA, NPRECT, NPSPHE, NPTRAP

ROUTINE NAME: NPTRAP

DESCRIPTION: This routine, given the nodal dimensions in the SCS generates the plot calls necessary to draw a trapezoid.

CALLING SEQUENCE: CALL NPTRAP

REFERENCES: NPMAIN

ROUTINE NAME: NUMBER

DESCRIPTION: This routine, given a value and a format, generates a number on the plot frame.

CALLING SEQUENCE: CALL NUMBER (X, F)

X	- Floating or integer number to be output
F	- Output format

REFERENCES: NPINFO, OPINFO, PLDRIV, PLGRID

ROUTINE NAME: ODATA

DESCRIPTION: This routine is user-called to define orbit data plotter options.

CALLING SEQUENCE: CALL ODATA (NV, SCL, SCLR, RPLN, TRUE, TIMEP, ISELN, ITIT, NPHF, NPSI, NOMI, OMI, PSI, PHI)

KEY VARIABLES: See Appendix D of users manual.

REFERENCES: User-called in the Operations Data block

ROUTINE NAME: OPAXES

DESCRIPTION: This routine defines the size and orientation of all characters to be small and horizonal, and draws and labels the CCS axis and sun line.

CALLING SEQUENCE: CALL OPAXES

REFERENCES: OPMAIN

ROUTINE NAME: OPCOMB

DESCRIPTION: This routine does matrix multiplication of the A and B input matrices and returns the results in matrix C.

CALLING SEQUENCE: CALL OPCOMB (A, B, C)

A - Input 3 x 3 matrix
B - Input 3 x 3 matrix
C - Resultant matrix (C = A*B)

REFERENCES: OPLOC

ROUTINE NAME: OPCONE

DESCRIPTION: This routine, given the surface dimensions in the SCS, generates the portion of the cone defined, converts it to the CCS, and plots the results.

CALLING SEQUENCE: CALL OPCONE

REFERENCES: OPMAIN

ROUTINE NAME: OPCONV

DESCRIPTION: This routine converts the plot control data from common and checks for errors. If no data are defined in common, it sets up the proper default parameters.

CALLING SEQUENCE: CALL OPCONV (NV, NNP, KEND)

NV - Plot view frame number

NNP - Number of nodes to be selectively plotted

KEND - End flag determining if more plots are needed

REFERENCES: OPMAIN

ROUTINE NAME: OPCYLO

DESCRIPTION: This routine, given the surface/nodal dimensions in the SCS, determines the proper plot calls to draw a cylinder.

CALLING SEQUENCE: CALL OPCYLO

REFERENCES: OPMAIN

ROUTINE NAME: OPDISC

DESCRIPTION: This routine, given the surface/nodal dimensions in the SCS- determines the proper plot calls to draw a disk.

CALLING SEQUENCE: CALL OPDISC

REFERENCES: OPMAIN

ROUTINE NAME: OPDOTL

DESCRIPTION: This routine connects P1 and P2 with a dotted line.

CALLING SEQUENCE: CALL OPDOTL (X1, Y1, Z1, X2, Y2, Z2)

X1, Y1, Z1 - Coordinates of P1

X2, Y2, Z2 - Coordinates of P2

REFERENCES: OPCONE, OPCYLO, OPPARA, OPSPHE

ROUTINE NAME: OPEDOT

DESCRIPTION: This routine generates the dotted lines used in the planet- and planet-shadow generation routines and connects points P1 and P2.

CALLING SEQUENCE: CALL OPEDOT (X1, Y1, Z1, X2, Y2, Z2, A)

X1, Y1, Z1 - Coordinates of P1
X2, Y2, Z2 - Coordinates of P2
A - Factor determining the length of the line increment

REFERENCES: OPPLAN, OPSHAD

ROUTINE NAME: OPFPLT

DESCRIPTION: This routine directs the actions of the plot pen/beam. I may be even or odd, negative or positive. The value of I directs the plotter to the coordinates X, Y with the pen up or down.

CALLING SEQUENCE: CALL OPFPLT (I, X, Y)

I - Plot designator
= Even, draw to (X, Y)
= Odd position
= Positive (generates new origin)
= Negative (keep same origin)

REFERENCES: OPAXES, OPCONE, OPDOTL, OPTPLT, OPDISC, OPPARA, OPRECT, OPEDOT, OPSPHE, OPTRAP, OPVCS

ROUTINE NAME: OPINFO

DESCRIPTION: This routine labels all plot alphabetic data on the plot frame.

CALLING SEQUENCE: CALL OPINFO (NV, KEND)

NV - View frame number
KEND - Error flag

REFERENCES: OPMAIN

ROUTINE NAME: OPLOC

DESCRIPTION: This routine, given the oribital parameters, determines the proper direction cosine matrix to give the proper orientation.

CALLING SEQUENCE: CALL OPLOC

REFERENCES: OPMAIN

ROUTINE NAME: <u>OPMAIN</u>

DESCRIPTION: This is the main driving logic to control the orbit plot link.

CALLING SEQUENCE: CALL OPMAIN

REFERENCES: OPPROG (preprocessor-generated)

ROUTINE NAME: <u>OPMAX</u>

DESCRIPTION: This routine determines the maximum radius needed to enclose any surface. This value is then used to determine the proper scale factor.

CALLING SEQUENCE: SCL = OPMAX (NNP)

NNP - Number of surfaces to be selectively plotted

REFERENCES: OPMAIN, OPCONV

ROUTINE NAME: <u>OPPARA</u>

DESCRIPTION: This routine, given the surface dimensions in the SCS, generates the plot calls necessary to draw a paraboloid.

CALLING SEQUENCE: CALL OPPARA

REFERENCES: OPMAIN

ROUTINE NAME: OPPLAN

DESCRIPTION: This routine, given the desired planet radius for plotting (in inches), generates the logic necessary to draw the planet.

CALLING SEQUENCE: CALL OPPLAN

REFERENCES: OPMAIN

ROUTINE NAME: OPPRNT

DESCRIPTION: This routine generates a summary table of orbital parameters on the output file.

CALLING SEQUENCE: CALL OPPRNT

REFERENCES: OPMAIN

ROUTINE NAME: OPPROG

DESCRIPTION: This routine is generated by the preprocessor. It defines the necessary labeled common blocks and the calls into the main driving logic.

CALLING SEQUENCE: CALL OPPROG

REFERENCES: TRASYS (root segment)

ROUTINE NAME: OPRECT

DESCRIPTION: This routine, given the surface dimensions, generates the plot calls to draw a rectangle.

CALLING SEQUENCE: CALL OPRECT

REFERENCES: OPMAIN

ROUTINE NAME: OPROTA

DESCRIPTION: This routine defines the transformed direction cosine matrix, given the desired view.

CALLING SEQUENCE: CALL OPROTA

KEY VARIABLES: KC - Desired view number
PH, PS, OM - Angles necessary to arrive at desired view

REFERENCES: OPMAIN

ROUTINE NAME: OPSCAL

DESCRIPTION: This routine determines the grid subject space, maps into the new space, and locates the pen/beam at the new origin.

CALLING SEQUENCE: CALL OPSCAL (XS, YS, X, Y)

XS - Scale factor
YS - Scale factor
X = 0
Y = 0

REFERENCES: OPAXES

ROUTINE NAME: OPSHAD

DESCRIPTION: This routine draws the planet shadow.

CALLING SEQUENCE: CALL OPSHAD

REFERENCES: OPMAIN

ROUTINE NAME: OPSPHE

DESCRIPTION: This routine, given the surface dimensions, generates the plot calls necessary to draw a sphere or segment of a sphere.

CALLING SEQUENCE: CALL OPSPHE

REFERENCES: OPMAIN

ROUTINE NAME: OPTIME

DESCRIPTION: This routine, given the eccentricity, true anomaly, and orbital period, computes the present orbital time.

CALLING SEQUENCE: CALL OPTIME (TIME, PER, ECC, TRU)

TIME - Computed orbital time
PER - Orbit period
ECC - Orbit eccentricity
TRU - True anomaly angle

REFERENCES: OPLOC

ROUTINE NAME: OPTPLT

DESCRIPTION: This routine transforms a point in 3-D space to X, Y coordinates in the subject space, checks to determine if the points are in the allowable range, and moves the pen/beam to the coordinates of that point.

CALLING SEQUENCE: CALL OPTPLT (I, XP, YP, X3, Y3, Z3)

I - Pen-up, pen-down flag
XP, YP - Coordinates of transformed point
X3, Y3, Z3 - Coordinates of input point

REFERENCES: OPCONE, OPCYLO, OPDISC, OPPARA, OPSPHE, OPPRECT, OPTRAP

ROUTINE NAME: OPTRAP

DESCRIPTION: This routine, given the surface dimensions in the SCS, generates the plot calls necessary to draw a trapezoid.

CALLING SEQUENCE: CALL OPTRAP

REFERENCES: OPMAIN

ROUTINE NAME: OPTRNP

DESCRIPTION: This routine, given a 3 x 3 matrix, computes the transpose.

CALLING SEQUENCE: CALL OPTRNP (A, B)

A - 3 x 3 matrix to be transposed
B - 3 x 3 resultant matrix

REFERENCES: OPDOTL, OPTPLT, OPLOC

ROUTINE NAME: OPTRS3

DESCRIPTION: This routine changes a translation vector from one coordinate system to the corresponding translation vector in the new system.

CALLING SEQUENCE: CALL OPTRS3 (X, Y, Z, A, B, C, RX, RY, RZ, TRAN)

X, Y, Z - New translation vector
A, B, C - Translation vector in the old system
RX, RY, RZ - Translation vector in the new system
TRAN - Direction cosines relating the old system to the new system

REFERENCES: OPAXES, OPDOTL, OPTPLT, OPEDOT, OPVCS

ROUTINE NAME: OPUNIT

DESCRIPTION: This routine generates an identity matrix.

CALLING SEQUENCE: CALL OPUNIT (A)

A - Output unit matrix

REFERENCES: OPLOC

ROUTINE NAME: OPVCS

DESCRIPTION: This routine labels the vehicle axes on the plot.

CALLING SEQUENCE: CALL OPVCS

REFERENCES: OPMAIN

ROUTINE NAME: ORBIT1

DESCRIPTION: This routine can be called by the user in the Operations Data block to define the orbit.

CALLING SEQUENCE: CALL ORBIT1 (PLANAM, ALANI, APEI, OIN, TIME, HPI, HAI, SRA, SDE, STA, STD)

KEY VARIABLES: See users manual, Appendix D

REFERENCES: ODPROG

ROUTINE NAME: ORBIT2

DESCRIPTION: This is a user callable routine to define the desired orbit.

CALLING SEQUENCE: CALL ORBIT2 (PLANAM, CIG, BET, CIGS, BETS, TIME, HPI, HAI)

KEY VARIABLES: See users manual, Appendix D

REFERENCES: ODPROG

ROUTINE NAME: ORIENT

DESCRIPTION: This routine allows the user to define the vehicle orientation.

CALLING SEQUENCE: CALL ORIENT (TYPE, IROTX, IROTY, IROTZ, ROTX, ROTY, ROTZ)

KEY VARIABLES: See users manual, Appendix D

REFERENCES: ODPROG

ROUTINE NAME: PAGE

DESCRIPTION: This routine is called prior to every written statement to the output file to count the line printed and take care of all paging.

CALLING SEQUENCE:
```
II = PAGE (I)
II = 0 New page was written
     1 No new page
 I - Number of lines to be printed
```

REFERENCES: All output generating routines.

ROUTINE NAME: PDUMP

DESCRIPTION: This routine, given a starting address, a final address, and a type of address, dumps all cells in between.

CALLING SEQUENCE: CALL PDUMP (IS, IE, IT)

IS - First word to start dumping from
IE - Last word of dump
IT - Type of dump
= 0-3 Actual
= 1 Real
= 2 Integer

ROUTINE NAME: PLCFIT

DESCRIPTION: This routine does smooth-curve fitting. Given two arrays LO words long (X, Y), it generates NO points between each set of X, Y points and stores the points in arrays U and V.

CALLING SEQUENCE: CALL PLCFIT (LO, X, Y, NO, U, V)

LO	- Number of input points
X	- Independent variable array
Y	- Dependent variable array
NO	- Number of divisions between each set of points
U, V	- Output arrays

REFERENCES: PLDCON

ROUTINE NAME: PLDATA

DESCRIPTION: This routine can be called by the user in the Operations Data block to define PLOT link options.

CALLING SEQUENCE: CALL PLDATA (IP, INS, IS, CRVF, TLX, TLY, T1, T2, XMPF, YMPF)

KEY VARIABLES: See users manual, Appendix D

REFERENCES: Operations Data block

ROUTINE NAME: PLDCON

DESCRIPTION: This routine checks for discontinuities in the output plot and calls for curve fitting between all discontinuities.

CALLING SEQUENCE: CALL PLDCON (NTIME, TIME, PARRAY, NODIV, NTOT, TIMP, PLOTP)

NTIME - Number of orbit points
TIME - Array of times
PARRAY - Array of dependent data
NODIV - Number of divisions between each point
NTDT - Number of output points
TIMP - Array of curve-fit points (independent)
PLOTP - Array of curve-fit points (dependent)

REFERENCES: PLDRIV

ROUTINE NAME: PLDRIV

DESCRIPTION: This routine is the main driving routine in the plot link. It decodes the type of plot and calls the proper routines.

CALLING SEQUENCE: CALL PLDRIV (RINDEP, S, DEPEND, RINDO, DEPO, IS, NDIV, NINDV)

RINDEP - Independent variable array
S - Temporary working array
DEPEND - Dependent variable array
RINDO - Independent variable array computed
DEPO - Dependent variable array output
IS - Temporary array (same as S)
NDIV - Number of divisions between curve-fit points
NINDV - Number of independent variable points allowed

REFERENCES: PLMAIN

ROUTINE NAME: PLGRID

DESCRIPTION: This routine draws the plot grid and labels the complete frame.

CALLING SEQUENCE: CALL PLGRID (XMIN, XMAX, YMIN, YMAX, NODEN)

XMIN, XMAX, YMIN, YMAX - Minimum and maximum dimensions of plot frame
NODEN - Node number of current frame

REFERENCES: PLDRIV

ROUTINE NAME: PLLOAD

DESCRIPTION: This routine determines the type of plot and locates and finds the plot data if absorbed or incident flux data are to be plotted.

CALLING SEQUENCE: CALL PLLOAD (DATA, TIME, ITIME, NTIME, NINDV)

DATA - Working temporary array
TIME, ITIME - Doublet array containing time and step number
NTIME - Number of time points
NINDV - Number of independent-variable points

REFERENCES: PLMAIN

ROUTINE NAME: PLMAIN

DESCRIPTION: This is the main driving routine in the plot segment. Its primary functions are to determine the size of the array and allocate array space.

CALLING SEQUENCE: CALL PLMAIN

REFERENCES: PLPROG (preprocessor-generated)

ROUTINE NAME: PLOUT

DESCRIPTION: This routine applies the dependent variable multiplier and converts fluxes to rates.

CALLING SEQUENCE: CALL PLOUT (NV, A1, A2, A3, A4, ITYPE)

NV - Number of arrays
A1, A2, A3, A4 - Data arrays
ITYPE - Flag indicating flux or rate
= 4HFLUX heat flux
= 4HRATE heat rate

REFERENCES: FNDFLP

ROUTINE NAME: PLPROG

DESCRIPTION: This routine is generated by the preprocessor and calls in the main processor routines.

CALLING SEQUENCE: CALL PLPROG

REFERENCES: TRASYS (root segment)

ROUTINE NAME: PLSCL

DESCRIPTION: This routine, given the maximum and minimum values, determines a scale using convenient units.

CALLING SEQUENCE: CALL PLSCL (BMAX, BMIN, NSQ, AU, AL, S)

BMAX, BMIN - Maximum and minimum values to be plotted
NSQ - Increment desired
AU, AL - New upper and lower values
S - Scale factor

REFERENCES: PLGRID

ROUTINE NAME: PLSYMB

DESCRIPTION: This routine, given an array of Hollerith data, outputs the data to the plot frame and supplies the proper character terminator.

CALLING SEQUENCE: CALL PLSYMB (ARRAY, N)

ARRAY - Array of data to be printed
N - Number of words in array

REFERENCES: PLGRID

ROUTINE NAME: PLUTOD

DESCRIPTION: This routine defines the orbital parameter concerning the planet Pluto.

CALLING SEQUENCE: CALL PLUTOD

KEY VARIABLES: PNAME - Planet name
RSUN - Radius of sun
ASUN - Area of sun
PRAD - Planet radius
PSD - Planet-sun distance
TSUN - Temperature of sun
SOL - Solar constant
PALB - Planet albedo factor
WDS - Darkside temperature
WSS - Sun side temperature
GRAV - Gravitational constant

REFERENCES: ORBIT1, ORBIT2

ROUTINE NAME: QOAVGR

DESCRIPTION: This routine computes the integrated average of the incident fluxes that were input.

CALLING SEQUENCE: CALL QOAVGR (NTIME, TIME, NUNIT)

NTIME - Number of time points
TIME - Doublet array of time and step number
NUNIT - Unit number sorted fluxes are stored on

REFERENCES: QOMAIN

ROUTINE NAME: QOAVGS

DESCRIPTION: This routine, given the final data, outputs the data according to the user requirements.

CALLING SEQUENCE: CALL QOAVGS (NODNO, QAV, AREAT)

NODNO - Node number
QAV - Averaged Q value
AREAT - Area of node

REFERENCES: QOSAVE

ROUTINE NAME: QOCMBN

DESCRIPTION: This routine generates the combining data read from the correspondence data.

CALLING SEQUENCE: CALL QOCMBN (ICOMBL, IFIRSL)

ICOMBL - Number of points in Combine Array 1
IFIRSL - Number of points in Combine Array 2

REFERENCES: QOMAIN

ROUTINE NAME: QOCOMB

DESCRIPTION: Based on the combine arrays, this routine combines and stores the data. A final call to this routine causes the combined tables to be output

CALLING SEQUENCE: CALL QOCOMB (DATA1, DATA2, ND1M1, ND1M2, ND1M, IFIRSL, ICOMBL, DATA, IROW, KTAB)

DATA1, DATA2	- Working storage blocks
ND1M1, ND1M2	- Length of data blocks 1 and 2
ND1M	- Number of nodes
IFIRSL, ICOMBL	- Length of combining arrays
DATA	- Working storage array
IROW	- Sequence number of current row
KTAB	- Table number

REFERENCES: QOSAVE

ROUTINE NAME: QODATA

DESCRIPTION: This routine is called by the user to define particular parameters for the incident flux output QOCAL.

CALLING SEQUENCE: CALL QODATA (IARRAY, NTMARY, QOTP, SUN, AMPF, FMPF, TMPF, TYPE, NCOR)

KEY VARIABLES: See users manual, Appendix D for definition of variables

REFERENCES: Operations Data block

ROUTINE NAME: QOFLIP

DESCRIPTION: This routine, given a matrix (NTIME x ICOL) stored on disk NS1, converts this to a matrix (ICOL x NTIME) on unit NS2.

CALLING SEQUENCE: CALL QOFLIP (DATA, NTIME, ICOL, NS1, NS2)

DATA	- Working storage area
NTIME	- Number of rows
ICOL	- Number of columns
NS1, NS2	- Input, output unit numbers

REFERENCES: QOMAIN

ROUTINE NAME: QOHEAD

DESCRIPTION: This routine outputs default and user control parameters to the output file.

CALLING SEQUENCE: CALL QOHEAD

REFERENCES: QOMAIN

ROUTINE NAME: QOMAIN

DESCRIPTION: This routine is the main driving logic for the QØCAL link.

CALLING SEQUENCE: CALL QOMAIN

REFERENCES: QOPROG

ROUTINE NAME: QOPROG

DESCRIPTION: This routine is defined by the preprocessor. It defines all needed labeled common blocks and calls in the driving logic.

KEY VARIABLES: CALL QOPROG

REFERENCES: TRASYS (root segment)

ROUTINE NAME: QOSAVE

DESCRIPTION: This routine reads the uncombined data points and, from the input options directs the combining and output options.

CALLING SEQUENCE: CALL QOSAVE (ICOMBL, IFIRSL, NTIME, TIME)

ICOMBL, IFIRSL - Length of the combining arrays
NTIME - Number of time points
TIME - Double array of step numbers and times

REFERENCES: QOMAIN

ROUTINE NAME: QOSBCD

DESCRIPTION: This routine is called to output the subroutine Call cards.

CALLING SEQUENCE: CALL QOSBCD (PER, ITIME, KTAB, AREAT, NODNO)

PER	- Orbit period
ITIME	- Time array number
KTAB	- Table number reference number
AREAT	- Area
NODNO	- Node number

REFERENCES: QOSAVE

ROUTINE NAME: QOTABS

DESCRIPTION: This routine is called to generate the final output tables.

CALLING SEQUENCE: CALL QOTABS (KTAB, DATA, NTIME, ARE)

KTAB	- Output array number
DATA	- Arrays of Q data
NTIME	- Number of data points
ARE	- Area of node

REFERENCES: QOSAVE

ROUTINE NAME: QOTIMES

DESCRIPTION: This routine is called to output the time array in final form.

CALLING SEQUENCE: CALL QOTIMES (ITME, TIME, NTIME)

ITME	- Time array number
TIME	- Array of times
NTIME	- Number of time points

REFERENCES: QOSAVE

ROUTINE NAME: RBAREA

DESCRIPTION: This is a function routine that calculates elemental areas for unevenly distributed elements of unequal size.

CALLING SEQUENCE: RBAREA (ILP, ALPH, BMIN, BMAX, GMIN, GMAX)

ILP - Surface type
ALPH -
BMIN -
BMAX - } Surface dimensions of current element
GMIN -
GMAX -

REFERENCES: RBEXPN

ROUTINE NAME: RBCAL

DESCRIPTION: This routine contains the driving logic to determine the number and distribution of elements on node IN, as well as on the image of node JN as seen in specular surface MIRROR. It also calculates the image factor from node IN to node JN.

CALLING SEQUENCE: CALL RBCAL (MIRROR)

MIRROR - Surface sequence number of current specular surface

KEY VARIABLES: IN, JN - Sequence numbers of current node pair
FE, FA - IR and solar form factors from node IN to image of node JN in specular surface MIRROR
WE, WA - IR and solar shadowing factors
RBVALI, RBVALS - IR and solar image factors between node IN and node JN
KN - Sequence number of current specular node
SREFLI, SREFLS - Arrays of IR and solar specular reflectance values

REFERENCES: RBPRE

FILES: NOUT - System output file

ROUTINE NAME: RBELEM

DESCRIPTION: Given the number of elements in each direction, this routine calculates the elemental position and area vectors.

CALLING SEQUENCE: CALL RBELEM (NB, NG, ILP, IC, DATA, POS, ARA, TRAN, RX, RY, RZ)

NB, NG - Number of elements in the beta and gamma directions
ILP - Surface type
IC - Counter for total number of elements on node pair
DATA - Array of node dimensions
POS - Array of elemental position vectors
ARA - Array of elemental area vectors
TRAN - Matrix of direction cosines
RX, RY, RZ - Components of SCS origin position vector in the ICS, BCS, or CCS

REFERENCES: RBCAL, RBEXPN

ROUTINE NAME: RBELSL

DESCRIPTION: Given the total number of elements required on a node, this routine makes them as square as possible and determines the number of elements in each direction.

CALLING SEQUENCE: CALL RBELSL (NB, NG, ILP, DATA, NTOT)

NB, NG - Number of elements in the beta and gamma directions
ILP - Surface type
DATA - Array of node dimensions
NTOT - Number of elements required on a node

REFERENCES: RBCAL, RBEXPN

ROUTINE NAME: RBEND

DESCRIPTION: This routine provides for user intervention after the image factor calculation. It normally calls for a time accounting for the problem and end-files the image factor file on NFF.

CALLING SEQUENCE: CALL RBEND

REFERENCES: RBMAIN

FILES: NFF - Disk file for storing image factors.

ROUTINE NAME: RBESUM

DESCRIPTION: This routine provides an accounting, in CP seconds, of the time required to calculate image factors.

CALLING SEQUENCE: CALL RBESUM

REFERENCES: RBEND

FILES: NOUT - System output file

ROUTINE NAME: RBEXPN

DESCRIPTION: This routine expands nodes into subnodes, determines the number and distribution of elements on each subnode, and calculates more accurate image factors than would be possible on a nodal basis.

CALLING SEQUENCE: CALL RBEXPN (POSI, ARAI, FE, FA, RATI, RATJ, JFLAG, JST, NEI, NEJ, NSUR, IADDR, MIRROR)

POSI - Array of elemental position vectors
ARAI - Array of elemental area vectors
FE, FA - Resultant IR and solar form factors
RATI, RATJ - Ratio of maximum number of elements indicated by arithmetic average
JFLAG - Flag indicating that maximum number of elements was exceeded
JST - Number of possible shadowers
NEI, NEJ - Number of elements on nodes I and J
NSUR - Actual number of shadowing surfaces
IADDR - Maximum time return sequence (not used)
MIRROR - Surface sequence number of current specular surface

REFERENCES: RBCAL

ROUTINE NAME: RBGTST

DESCRIPTION: This is an integer function routine that tests a given value, GT, to determine if it falls in the range $GN \leq GT \leq GX$. If it does, the function value is 0 (zero); if not, the function value is 1 (one).

CALLING SEQUENCE: RBGTST (GN, GX, GT)

GN - Lower bound
GX - Upper bound
GT - Value to be tested

REFERENCES: RBSHD

ROUTINE NAME: RBIMAG

DESCRIPTION: This routine images surfaces for shadowing purposes and stores the results on NSCR2 for later use.

CALLING SEQUENCE: CALL RBIMAG (NST)

NST - Total number of shadowing surfaces

KEY VARIABLES:
JS - Surface sequence number of current specular surface
NSURFS - NST plus number of images in specular surface JS
IFS, IKS, PR, DSTR, EIMJ, PSH, TSTR - Surface description parameters

REFERENCES: RBMAIN

FILES: NSCR2 - Scratch file

ROUTINE NAME: RBMAIN

DESCRIPTION: This routine contains the main driving logic for calculating image factors.

CALLING SEQUENCE: CALL RBMAIN

KEY VARIABLES:
IN - Sequence number of "viewer" node
JN - Sequence number of node whose image in KN is viewed by IN
KN - Sequence number of specular node
ISPEC - Array of specular surface sequence numbers

REFERENCES: RBPROG (preprocessor-developed)

FILES: NRAN - Random access file
NSCR2 - Scratch file

ROUTINE NAME: <u>RBNIMG</u>

DESCRIPTION: This routine images the current node JN in the current specular surface.

CALLING SEQUENCE: CALL RBNIMG (JM, NOIM)

JM - Surface sequence number of current specular surface

NOIM - Flag to indicate if an image of the current node exists in JM
= 0, an image exists
= 1, no image

KEY VARIABLES: POSNJ, RXJ, RYJ, RZJ, DATAJ, TRANJ } Nodal description parameters

REFERENCES: RBMAIN

FILES: NRAN - Random access file

ROUTINE NAME: <u>RBOUT</u>

DESCRIPTION: This is a user routine that can be replaced to change the form of output for image factors. The normal calls are to RBPNCH (punches image factors) and RBPRNT (prints image factors).

CALLING SEQUENCE: CALL RBOUT

REFERENCES: RBMAIN

ROUTINE NAME: <u>RBPNCH</u>

DESCRIPTION: This routine punches the image factor between node IN and node JN. The user can override this routine to change the output format if he desires.

CALLING SEQUENCE: CALL RBPNCH

KEY VARIABLES:

IN - Sequence number of "viewer" node
JN - Sequence number of "viewee" node
NODE - Array of node numbers
RBVALI, RBVALS - IR and solar image factors
ISTPDR - Array of step numbers

REFERENCES: RBOUT

FILES: PUNCH - System punch file

ROUTINE NAME: RBPOSI

DESCRIPTION: This routine transposes a vector in the ICS, BCS, or CCS into the SCS of the current specular surface, negates the Z component, and transforms the vector back into the ICS, BCS, or CCS.

CALLING SEQUENCE: CALL RBPOSI (X, Y, Z, TRAN)

X, Y, Z - Components of vector in the SCS
TRAN - Matrix of direction cosines

KEY VARIABLES: A, B, C - Components of vector in the ICS, BCS, or CCS

REFERENCES: RBIMAG, RBNIMG

ROUTINE NAME: RBPRE

DESCRIPTION: This routine provides for user intervention prior to the calculation of an image factor. The normal call is to RBCAL, which calculates the image factor.

CALLING SEQUENCE: CALL RBPRE (MIRROR)

MIRROR - Surface sequence number of current specular surface

REFERENCES: RBMAIN

ROUTINE NAME: RBPRNT

DESCRIPTION: This routine points the image factor between node IN and node JN. The user can override this routine to change the output format if he desires.

CALLING SEQUENCE: CALL RBPRNT

KEY VARIABLES: IN - Sequence number of "viewer" node
JN - Sequence number of "viewee" node
NODE - Array of node numbers
RBVALI, RBVALS - IR and solar image factors

REFERENCES: RBOUT

FILES: NOUT - System output file

ROUTINE NAME: RBPSHD

DESCRIPTION: This routine determines all possible shadowing surfaces between node IN and the image of node JN in specular surface MIRROR.

CALLING SEQUENCE: CALL RBPSHD (RADJ, RADI, POSJ, POSI, NSURF, NSS, JST, IN, JN, MIRROR)

RADJ, RADI	- Radii of sphere enclosing nodes IN and JN
POSJ, POSI	- Position vectors of enclosing spheres
NSURF	- Number of shadowing surfaces
NSS	- NSURF plus all surface images in specular surface MIRROR
JST	- Number of possible shadowing surfaces found
IN, JN	- Sequence numbers of surfaces containing nodes IN and JN
MIRROR	- Sequence number of current specular surface

REFERENCES: RBCAL, RBEXPN

ROUTINE NAME: RBRDIN

DESCRIPTION: This routine sets up the shadowing data arrays, reads form factors from the NFF file written in the FF link and writes them on a scratch file for later use, and initializes the NFF file for storage of image factors.

CALLING SEQUENCE: CALL RBRDIN

KEY VARIABLES:

NSPEC	- Number of active specular surfaces
NSURF	- Number of shadowing surfaces
DIMS, TSTR, DSTR, IFS, IKS, PR, PSH	- Shadowing data arrays
ISPEC	- Array of specular surface sequence numbers
SREFLI, SREFLS	- IR and solar specular reflectance arrays

REFERENCES: RBMAIN

FILES:

NFF	- Disk file for storage of image factors
NFFR	- Image factor restart file
NOUT	- System output file
NRAN	- Random access file
NSCR1	- Scratch file

ROUTINE NAME: RBRDRQ

DESCRIPTION: This routine initializes the image factor arrays and reads restart values if they are available.

CALLING SEQUENCE: CALL RBRDRQ

KEY VARIABLES: FFVALI, FFVALS - IR and solar form factors from the FF link.
Also used for image factor restart values
RBVALI, RBVALS - IR and solar image factor arrays

REFERENCES: RBMAIN

FILES: NFFR - Image factor restart file
NOUT - System output file
NSCR1 - Scratch file

ROUTINE NAME: RBROW

DESCRIPTION: This routine writes image factor data on file NFF by rows.

CALLING SEQUENCE: CALL RBROW

KEY VARIABLES: IN - Image factor row number
NODE - Array of node numbers
RBVALI, RBVALS - IR and solar image factors

REFERENCES: RBMAIN

FILES: NFF - Disk file for storing image factors

ROUTINE NAME: RBRPSN

DESCRIPTION: This routine calculates the minimum radius of a sphere that will encompass a given subnode and determines the position vector to the center of the sphere.

CALLING SEQUENCE: CALL RBRPSN (RADN, POSN, ILK, DATA, BETA, GAMMA, DB, DG)

RADN - Radius of encompassing sphere
POSN - Position vector of sphere
ILK - Surface type of node
DATA - Surface dimension values
BETA - Distance from edge of node to center of current subnode in the beta direction
GAMMA - Distance from edge of node to center of current subnode in the gamma direction
DB, DG - Dimensions of subnode in the beta and gamma directions

REFERENCES: RBEXPN

ROUTINE NAME: RBRSUM

DESCRIPTION: This routine prints out the time required to calculate one row of image factors.

CALLING SEQUENCE: CALL RBRSUM

REFERENCES: RBROW

FILES: NOUT - System output file

ROUTINE NAME: RBSHD

DESCRIPTION: This routine calculates the elemental shadowing between surfaces IN and the image of surface JN in specular surface MIRROR. An element is either completely shadowed or not shadowed at all. Shadowing is reduced by the transmissivity semitransparent shadowing surfaces.

CALLING SEQUENCE: CALL RBSHD (ILKI, RX, RY, RZ, POSI, WE, WA, JST, IN, JN, I, NSS, RS, MIRROR)

KEY VARIABLES:
ILKI - Surface type in IN
RX, RY, RZ - Components of vector from element on node I to element on node J
POSI - Array of elemental position vectors
WE, WA - Elemental shadowing factors for IR and solar image factors
JST - Number of possible shadowing surfaces
IN, JN - Surface sequence numbers
I - Element sequence number
NSS - Number of possible shadowers (including images)
RS - Square of the magnitude of the element-to-element connecting vector (RX^2 + RY^2 + RZ^2)
MIRROR - Sequence number of current specular surface

REFERENCES: RBCAL, RBEXPN

ROUTINE NAME: RBTMCK

DESCRIPTION: This routine calculates the time remaining in the run and compares it with the estimated time for the next calculation. If insufficient time remains, the run is aborted.

CALLING SEQUENCE: CALL RBRMCK (IADDR, MAXLFT)

IADDR - Not used
MAXLFT - Estimated time required for next calculation

KEY VARIABLES: M - Time remaining in run

REFERENCES: RBCAL, RBEXPN

FILES: NOUT - System output file

ROUTINE NAME: RBTRS3

DESCRIPTION: This routine transforms points in an SCS to points in the ICS, BCS, or CCS.

CALLING SEQUENCE: CALL RBTRS3 (X, Y, Z, A, B, C, RX, RY, RZ, TRAN)

X, Y, Z - Coordinates of point in the ICS, BCS, or CCS
A, B, C - Coordinates of point in the SCS
RX, RY, RZ - Components of the SCS origin position vector in the ICS, BCS, or CCS
TRAN - Matrix of direction cosines

REFERENCES: RBELEM

ROUTINE NAME: RBVIEW

DESCRIPTION: This routine calculates the unshadowed form factor between node IN and the image of node JN. It also calculates RATI and RATJ, which will later be compared with the user-input variable, FFRATL, to see if the nodes should be expanded into subnodes for better accuracy.

CALLING SEQUENCE: CALL RBVIEW (NTI, NTJ, POSI, ARAI, NTOTI, NTOTJ, ARI, ARJ, NOT, FRACT, RATI, RATJ)

NTI - Initial number of elements on node IN
NTJ - Total initial number of elements on node IN and the image of node JN
POSI - Array of elemental position vectors
ARAI - Array of elemental area vectors
NTOTI, NTOTJ - Number of elements required on node IN and the image of node JN
ARI, ARJ - Areas of node IN and the image of node JN
NOT - Flag to indicate whether node IN can "see" the image of node JN
= 0 Can see
= 1 Cannot see
FRACT - Unshadowed node-to-image form factor
RATI, RATJ - Ratios of indicated maximum elements required to NTOTI and NTOTJ

REFERENCES: RBCAL

ROUTINE NAME: RBVWT

DESCRIPTION: This routine calculates unshadowed form factors between subnodes and determines the number of elements required, based on a weighted-average criterion.

CALLING SEQUENCE: CALL RBVWT (NTI, NTJ, POSI, ARAI, NTOTI, NTOTJ, ARI, ARJ, NOT, FRACT)

NTI - Number of elements on the subnode of node IN

NTJ - Total number of elements on the subnode of node IN and the subnode of the image of node JN

POSI - Array of elemental position vectors

ARAI - Array of elemental area vectors

NTOTI, NTOTJ - Number of elements required on the subnodes of node IN and the image of node JN

ARI, ARJ - Areas of subnodes

NOT - Flag to indicate whether the subnode on node IN can "see" the image of node JN
= 0 Can see
= 1 Cannot see

FRACT - Unshadowed subnode-to-subnode form factor

REFERENCES: RBEXPN

ROUTINE NAME: RCBTP

DESCRIPTION: This routine generates a binary tape on unit USER1 that is acceptable as input into an intermediate Univac program.

CALLING SEQUENCE: CALL RCBTP (NI, NJ, SFA)

```
NI = 0 - Flag to complete write and end file
   = 0 - Node i
NJ     - Node j
SFA    - Script F times area value
```

KEY VARIABLES:

```
NIA  - Array 100 cells long used to block node i
NIA  - Array 100 cells long used to block node j
ASFA - Array 100 cells long used to block SFA
```

REFERENCES: RCOUT, RCMAIN

FILES: USER1

ROUTINE NAME: RCCMBN

DESCRIPTION: This routine, given an array defining combinations, combines and calls the output routines.

CALLING SEQUENCE: CALL RCCMBN (ICOMB, ICOMBL, SF, SPACNO, NUNIT)

```
ICOMB  - Array of combination data
ICOMBL - Length of ICOMB array
SF     - Temporary array to store script F
SPACNO - Array to store script F to space
NUNIT  - Unit containing gray-body matrix
```

REFERENCES: RCMAIN

FILES: NSCR3

ROUTINE NAME: RCDATA

DESCRIPTION: This routine is user-called in the Operations Data block and defines parameters for the RCAL link.

CALLING SEQUENCE: CALL RCDATA (NSGBIR, PNCH, FMIN, IRKN, RKSPC, NSPAC, SIG, AMPF, TAPE, RADI, NEFI, IPRIM, ISEC)

KEY VARIABLES: See user's manual, Appendix D

REFERENCES: Operations data block

ROUTINE NAME: RCEND

DESCRIPTION: This routine can be replaced by the user to intervene just prior to the end of the RCCAL link.

CALLING SEQUENCE: CALL RCEND

REFERENCES: RCMAIN

ROUTINE NAME: RCHEAD

DESCRIPTION: This routine prints the control parameters on the output file.

CALLING SEQUENCE: CALL RCHEAD

REFERENCES: RCMAIN

ROUTINE NAME: RCMAIN

DESCRIPTION: This is the main driving logic of the RCCAL link and directs the main logic flow.

CALLING SEQUENCE: CALL RCMAIN

REFERENCES: RCPROG (preprocess or generated)

ROUTINE NAME: RCMINC

DESCRIPTION: This routine eliminates small RADK's less than RKMIN by setting them to zero.

CALLING SEQUENCE: A = RCMINC (I, J, X)

I - Sequence number of node i
J - Sequence number of node j
X - RADK value
A - Flag indicating value returned
= 2HNO Value is greater than RKMIN
= 3HYES Value is less than RKMIN

REFERENCES: RCOUT

ROUTINE NAME: RCMRC

DESCRIPTION: This routine condenses the RADKs to account for the significant portion of the energy.

CALLING SEQUENCE: CALL RCMRC

REFERENCES: RCMAIN

ROUTINE NAME: RCOUT

DESCRIPTION: This routine outputs the original radiation conductors and saves the significant ones on unit NSCR1 for condensing.

CALLING SEQUENCE: CALL RCOUT (X, I, J)

X - Flag to output all radiation conductors
  - RADK value
I - Sequence number for node i
J - Sequence number for node j
  - Flag indicating a space radiation conductor

REFERENCES: RCCMBN, RCMAIN

ROUTINE NAME: RCPNCH

DESCRIPTION: This routine defines the final output form of the RADKs in the form of cards, BCD tape, or binary tape.

CALLING SEQUENCE; CALL RCPNCH (ICN, NI, NJ, SIG, SFA)

ICN - Conductor number
NI - Node i
NJ - Node j
SIG - Stephan-Boltzmann constant
SFA - Script F area factor

REFERENCES: RCOUT

FILES: BCDOU, USER1, PUNCH

ROUTINE NAME: RCPRE

DESCRIPTION: This routine can be replaced by the user to provide intervention prior to the RCCAL computation in the RCCAL link.

CALLING SEQUENCE: CALL RCPRE

REFERENCES: RCMAIN

ROUTINE NAME: RCPROG

DESCRIPTION: This routine is generated by the preprocessor. It defines all labeled common blocks required by the RCCAL link, as well as calls into the main logic.

CALLING SEQUENCE: CALL RCPROG

REFERENCES: TRASYS (root segment)

ROUTINE NAME: RCRORD

DESCRIPTION: This routine reorders the radiation conductors on the basis of increasing value.

CALLING SEQUENCE: CALL RCRORD (MAXBC, NNOD)

MAXBC - Not used
NNOD - Number of nodes

REFERENCES: RCMRC

FILES: NSCR1, NSCR2

ROUTINE NAME: RCSAVE

DESCRIPTION: This routine outputs the radiation conductors on a scratch file.

CALLING SEQUENCE: CALL RCSAVE (ICN, NI, NJ, SIG, SFA)

ICN - Conductor number
NI - Node i number
NJ - Node j number
SIG - Stephan-Boltzmann constant
SFA - Script F area factor

REFERENCES: RCOUT

FILES: NSCR1

ROUTINE NAME: RCSORT

DESCRIPTION: This routine sorts one array into another using a bin sorting technique.

CALLING SEQUENCE: CALL RCSORT (NN, IA, IB)

NN - Number of input points
IA - Input array
IB - Scratch array, length = NN

REFERENCES: RCRORD

ROUTINE NAME: RDMAIN

DESCRIPTION: This routine initializes the variables used in the processor via three methods;

1) Reads in the sequential file;
2) Sets variables with predefined data;
3) Reads in the random I/O file.

CALLING SEQUENCE: CALL RDMAIN

REFERENCES: RDPROG

FILES: NSQNTL, RTO

ROUTINE NAME: RDPROG

DESCRIPTION: This is a preprocessor-generated routine that calls the initialization routine.

CALLING SEQUENCE: CALL RDPROG

REFERENCES: TRASYS (root segment)

ROUTINE NAME: RIOPAC

DESCRIPTION: This routine was written for the Univac computer to simulate the CDC random access package.

CALLING SEQUENCE: CALL RIOPAC (NUNIT, FWA, NWDS, NR)

NUNIT - Unit number
FWA - Address of first word to read
NWDS - Number of words to be read
NR - Record number

REFERENCES: FFRDIN, DIRDIN, RDMAIN

ROUTINE NAME: RKBTP

DESCRIPTION: This routine generates a binary tape on unit USER1 that is acceptable as input into an intermediate Univac program.

CALLING SEQUENCE: CALL RKBTP (NI, NJ, SFA)

NI = 0 - Flag to complete write and end file unit
$\neq$ 0 - Node i number
NJ - Node j number
SFA - Script F times area value

KEY VARIABLES: NIA, NJA - Arrays 100 cells long used to block node numbers
ASFA - Array 100 cells long used to block script F values

REFERENCES: RKOUT, RKMAIN

ROUTINE NAME: RKCMBN

DESCRIPTION: This routine, given an array defining combinations, combines and calls the output routine.

CALLING SEQUENCE: CALL RKCMBN (ICOMB, ICOMBL, SF, SPACNO, NUNIT)

ICOMB - Array of combination data
ICOMBL - Length of ICOMB array
SF - Temporary array to store script F
SPACNO - Array to store script F to space
NUNIT - Unit containing gray-body matrix

REFERENCES: RKMAIN

ROUTINE NAME: RKDATA

DESCRIPTION: This routine is user-called in the Operations Data block and defines parameters for the RKCAL link.

CALLING SEQUENCE: CALL RKDATA (NSGBIR, PNCH, FMIN, IRKN, RKSPC, NSPAC, SIG, AMPF, TAPE)

KEY VARIABLES: See users manual, Appendix D

REFERENCES: Operations Data block

ROUTINE NAME: RKEND

DESCRIPTION: This routine can be replaced by the user to intervene just prior to the end of the RKCAL link.

CALLING SEQUENCE: CALL RKEND

REFERENCES: RKMAIN

ROUTINE NAME: RKHEAD

DESCRIPTION: This routine prints the user control parameters on the output file.

CALLING SEQUENCE: CALL RKHEAD

REFERENCES: RKMAIN

ROUTINE NAME: RKMAIN

DESCRIPTION: This is the main driving logic of the RKCAL link and directs the main logic flow.

CALLING SEQUENCE: CALL RKMAIN

REFERENCES: RKPROG (preprocessor-generated)

ROUTINE NAME: RKMINC

DESCRIPTION: This routine eliminates small RADKs less than RKMIN by setting them to zero.

CALLING SEQUENCE: A = RKMINC (I, J, X)

```
I - Sequence number of node i
J - Sequence number of node j
X - RADK value.
A - Flag indicating value returned
    = 2HNO Value is greater than RKMIN
    = 3HYES Value is less than RKMIN
```

REFERENCES: RKOUT

ROUTINE NAME: RKOUT

DESCRIPTION: This routine applies the area multiplier, calls to check minimum values, and calls for final outputting.

CALLING SEQUENCE: CALL RKOUT (X, I, J)

X - Flag to output all radiation conductors
  - RADK value
I - Sequence number of node i
J - Sequence number of node j
    flag indicating a space RADK

REFERENCES: RKCMBN, RKMAIN

ROUTINE NAME: RKPCH

DESCRIPTION: This routine defines the final output form of the RADKs in the form of cards, BCD tape, or binary tape

CALLING SEQUENCE: CALL RKPCH (ICN, NI, NJ, SIG, SFA)

ICN - Initial conductor value
NI - Node i
NJ - Node j
SIG - Stephan-Boltzmann constant
SFA - Script F area factor

REFERENCES: RKOUT

FILES: BCDOU, USER1, PUNCH

ROUTINE NAME: RKPRE

DESCRIPTION: This routine can be replaced by the user to provide intervention prior to the RKCAL computation in the RKCAL link.

CALLING SEQUENCE: CALL RKPRE

REFERENCES: RKMAIN

ROUTINE NAME: RKPROG

DESCRIPTION: This routine is generated by the preprocessor. It defines all labeled commons required by the RKCAL link, and calls in the main logic in RKMAIN.

CALLING SEQUENCE: CALL RKPROG

REFERENCES: TRASYS (root segment)

ROUTINE NAME: SATURD

DESCRIPTION: This routine sets up the planet parameters concerning the planet Saturn.

CALLING SEQUENCE: CALL SATURD

KEY VARIABLES: PRAD - Planet radius
SOL - Solar constant
PALB - Planet albedo factor
WDS - Planet darkside temperature
WSS - Planet sun side temperature
GRAV - Gravitational constant

REFERENCES: ORBIT1, ORBIT2

ROUTINE NAME: SETBEA

DESCRIPTION: This routine positions a plot beam at the coordinates of a point in the subject mapping.

CALLING SEQUENCE: CALL SETBEA (X, Y)

X, Y - Coordinates of point

REFERENCES: NPAXES, NPFPLT, NPSCAL, OPAXES, OPFPLT, OPSCAL, OPVCS, PLDRIV

ROUTINE NAME: SFCLCO

DESCRIPTION: This routine computes the clock and cone angles, given a position vector.

CALLING SEQUENCE: CALL SFCCCO (X, Y, Z, CL, CO)

X, Y, Z - Position vector input
CL - Computed corresponding clock angle
CO - Computed corresponding cone angle

REFERENCES: DICALS, DICALP

ROUTINE NAME: SFDATA

DESCRIPTION: This routine allows the user to define the control parameters for the SFCAL link. This routine is called from the Operations Data block.

CALLING SEQUENCE: CALL SFDATA (NT, NO)

NT - Configuration name of shadow factors on the PLSR file to use in the SFCAL link. If 0, recompute

NO - Configuration name to use when writing the SHADO and PLS files. If 0, do not write a tape

REFERENCES: Operations Data block

ROUTINE NAME: SFELAV

DESCRIPTION: This routine computes the position and area vectors for elements on a node given the nodal dimensions.

CALLING SEQUENCE: CALL SFELAV (ILP, DATA, TRAN, RX, RY, RZ, NB, NG)

ILP - Surface type

DATA - Array of surface dimensions

TRAN - Direct cosine matrix for node

RX, RY, RZ - Position vector for node

NB, NG - Number of elements in the two directions the node is to be divided into

REFERENCES: SFMAIN

ROUTINE NAME: SFELEM

DESCRIPTION: This routine, given the nodel dimensions and the total number of elements required, determines the number of elements in each direction.

CALLING SEQUENCE: CALL SFELEM (ILP, DATA, TRAN, RX, RY, RZ, NTOT)

ILP - Node type

DATA - Array of node dimensions

TRAN - Direction cosine matrix for node

RX, RY, RZ - Position vector for node

NTOT - Total number of elements required on node

REFERENCES: SFMAIN

ROUTINE NAME: SFELMT

DESCRIPTION: This routine establishes the minimum number of elements on a node to determine if a view is possible.

CALLING SEQUENCE: CALL SFELMT (NB, NG)

NB, NG - Minimum number of elements required to provide a representative view from the node

REFERENCES: SFMAIN

ROUTINE NAME: SFELSL

DESCRIPTION: This routine, given the total number of elements and the nodal dimensions, computes the number of elements in each direction to provide near-square elements.

CALLING SEQUENCE: CALL SFELSL (NB, NG, ILP, DATA, NTOT)

NB, NG - Computed number of elements required in various directions
ILP - Surface type
DATA - Array of surface dimensions
NTOT - Total number of elements to be used on the node

REFERENCES: SFMAIN

ROUTINE NAME: SFGBT

DESCRIPTION: This routine, given the allowable ranges on gamma concerning shadowing and given a gamma value, returns a 0 or 1 depending on the range.

CALLING SEQUENCE: CALL SFGTST (GN, GX, GT)

GN, GX - Minimum, maximum range
GT - Value to be checked

REFERENCES: SFSHAD

ROUTINE NAME: SFMAIN

DESCRIPTION: This is the main driving routine in the SFCAL link and directs the logic flow necessary to generate a shadow tape.

CALLING SEQUENCE: CALL SFMAIN

REFERENCES: SFPROG (preprocessor-generated)

ROUTINE NAME: SFPACK

DESCRIPTION: This routine packs 19 shadow-factor cone angles into one word and generates 19 words each time the routine is called. These 19 words are then written to PLS and SHADD (if requested) once every 10 calls. Entry point SFFLSH is called to write the last record and complete the writing sequence.

CALLING SEQUENCE: CALL SFPACK (TABSHA, ICNT)

TABSHA - Unpacked shadow factors
ICNT - A number from 0 to 9 designating which set of 10 nodes is currently being packed

REFERENCES: SFMAIN

ROUTINE NAME: SFPROG

DESCRIPTION: This routine is generated by the preprocessor and calls into the SFCAL link, and provides the necessary labeled commons.

CALLING SEQUENCE: CALL SFPROG

REFERENCES: TRASYS (root segment)

ROUTINE NAME: SFPSHS

DESCRIPTION: This routine determines which surfaces could possibly shadow between node i and the sun.

CALLING SEQUENCE: CALL SFPSHS (RADS, POS, SUNP, NSURF, NSHAD, IN)

RADS - Radius of node i
POS - Position vector of node i
SUNP - Position vector for sun
NSURF - Number of shadowing surfaces
NSHAD - Number of possible shadowers
IN - Sequence number of node i

KEY VARIABLES: ISHAD - Array of possible shadowers

REFERENCES: SFMAIN

ROUTINE NAME: SFRDIN

DESCRIPTION: This routine checks for restart information and sets the proper flags for the program. The shadowing surfaces are also set up in terms of the labeled commons.

CALLING SEQUENCE: CALL SFRDIN

REFERENCES: SFMAIN

ROUTINE NAME: SFRDRQ

DESCRIPTION: This routine reads in the restart data for one node at a time.

CALLING SEQUENCE: CALL SFRDRQ (IFLG, TABSHA, IN)

IFLG - Data check flag
= 2HNO No data found
= 3HYES Data found
TABSHA - Array of restart data for node i
IN - Sequence number for node i

REFERENCES: SFMAIN

ROUTINE NAME: SFSHAD

DESCRIPTION: This routine computes element-to-element shadowing between node i and the sun.

CALLING SEQUENCE: CALL SFSHAD (RX, RY, RZ, WE, WA, IN, I, NSS, RS)

RX, RY, RZ - Components of vector from element on node i to sun
WE, WA - Elemental shadowing factors for IR and solar
IN - Surface sequence numbers
I - Element sequence number
NSS - Number of possible shadowers
RS - Square of the magnitude of the element-to-sun connecting vector

REFERENCES: SFMAIN

ROUTINE NAME: SFTRS3

DESCRIPTION: This routine transforms points in an SCS to points in the ICS, BCS, or CCS.

CALLING SEQUENCE: CALL SFTRS3 (X, Y, Z, A, B, C, RX, RY, RZ, TRAN)

X, Y, Z - Coordinates of a point in the ICS, BCS, or CCS
A, B, C - Coordinates of the point in the SCS
RX, RY, RZ - Components of the SCS origin position vector in the ICS, BCS, or CCS
TRAN - Matrix of direction cosines

REFERENCES: SFELAV, SFELEM

ROUTINE NAME: SFUNCT

DESCRIPTION: This function, given a clock angle and a cone angle, interpolates the packed clock angle-cone angle array located in labeled common, computes the function value and stores the value in SFT.

CALLING SEQUENCE: A = SFUNCT (CL, CO SFT)

CL - Clock angle
CO - Cone angle
SFT, A - Interpolated value

REFERENCES: DICALS, DICALP

ROUTINE NAME: SHADPT

DESCRIPTION: This routine computes the shadow points, given the orbit definition.

CALLING SEQUENCE: CALL SHADPT

REFERENCES: ORBIT1, ORBIT2

ROUTINE NAME: SINX

DESCRIPTION: This routine computes the sine of an argument, in degrees.

CALLING SEQUENCE: CALL SINX (A)

A - Argument, in degrees

ROUTINE NAME: SKFILE

DESCRIPTION: This routine advances a unit N number of files.

CALLING SEQUENCE: CALL SKFILE (NUNIT, N)

NUNIT - Unit number
N - Number of files

REFERENCES: FINDST, STORE, QOMAIN

ROUTINE NAME: SORTDL

DESCRIPTION: This routine numerically sorts a doublet array within itself.

CALLING SEQUENCE: CALL SORTDL (IA, NA)

IA - Doublet array
NA - Total number of elements

REFERENCES: QOMAIN, PLLOAD

ROUTINE NAME: SORTS

DESCRIPTION: This routine numerically sorts a singlet array.

CALLING SEQUENCE: CALL SORTS (A, JJ)

A - Singlet input array
JJ - Number of elements in the array

ROUTINE NAME: SPIN

DESCRIPTION: This routine is user-callable and allows the user to define the spin axis, spin rate, and start time.

CALLING SEQUENCE: CALL SPIN (CLOC, CON, RAT, ANGLE, TIMS)

CLOC - Clock angle locating spin axes
CON - Cone angle locating spin axes
RAT - Spin rate
ANGLE - True anomaly angle to start spin
TIMS - Start time of spin

REFERENCES: User's Operations Data block

ROUTINE NAME: STFAQ

DESCRIPTION: This routine is user-called in the Operations Data block to generate a duplicate orbit point, given a true anomaly/time and a step number to retrieve the data from.

CALLING SEQUENCE: CALL STFAQ (ANGLE, TIM, NST)

ANGLE - True anomaly the data are to be stored under
TIM - Current orbital time data are to be stored under
NST - Step number to retrieve data from

REFERENCES: Operations Data block (user-called)

FILES: SCR1, DI, TQ

ROUTINE NAME: STORE

DESCRIPTION: This routine generates the header record on the required file. If the file has been rewound or read STORE repositions the file to the proper point.

CALLING SEQUENCE: CALL STORE (NUNIT, ISTEP, LABEL1, LABEL2)

NUNIT - Unit to write header on
ISTEP - Step number
LABEL1 - Identifier
LABEL2 - Identifier

REFERENCES: STFAQ, FFRDIN, SFROIN, DIEND, DIRDRQ, GBSCFA, AQMAIN

ROUTINE NAME: SUND

DESCRIPTION: This routine defines the parameters concerning the sun when the orbit defined includes the sun.

CALLING SEQUENCE: CALL SUND

KEY VARIABLES: PRAD - Planet radius
RSUN - Sun radius
WSUN - Sun temperature
PALB - Sun albedo factor (0.0)
WDS - Darkside temperature
WSS - Sun side temperature

REFERENCES: ORBIT1, ORBIT2

ROUTINE NAME: SYMBOL

DESCRIPTION: This routine generates Hollerith data on the plot frame. The sequence of characters is terminated by a ($.).

CALLING SEQUENCE: CALL SYMBOL (A)

A - Array of Hollerith data

REFERENCES: NPMAIN, NPAXES, NPINFO, OPMAIN, OPAXES, OPINFO, OPVCS, PLGRID, PLSYMB

ROUTINE NAME: TAPELS

DESCRIPTION: This routine is user-callable to list a BCD file on unit BCDOU. Given the number of files, each is listed with a sequence starting at 10,000 until 1 EOF is read or NFILES pseudo end-of-files are read, where C$END is treated as an end-of-file.

CALLING SEQUENCE: CALL TAPELS (NFILES)

NFILES - Number of pseudo end-of-files to be dumped

REFERENCES: User-called in the Operations Data block

ROUTINE NAME: TPLOAD

DESCRIPTION: This routine generates a binary tape containing all computed data at the current point under the configuration name NCFNM. The data are written in a multifile file on unit USER1.

CALLING SEQUENCE: CALL TPLOAD (NCFNM)

NCFNM - Configuration name

REFERENCES: User-called in the Operations Data block

FILES: USER1

ROUTINE NAME: TRANSF

DESCRIPTION: This routine combines the direction cosine matrices to generate a final C-S and S-C matrix.

CALLING SEQUENCE: CALL TRANSF (RMASS, TRANCB, BX, BY, BZ, TRANCS, TRANBS)

RMASS	- Array of surface data
TRANCB	- Direction cosine matrix central to block system
BX, BY, BZ	- Block coordinate component vector
TRANCS	- Direction cosine matrix central to surface

REFERENCES: BUILDC, ADD

ROUTINE NAME: TRASYS

DESCRIPTION: This is the root segment defined by the preprocessor enabling the operations data to direct all logic flow.

CALLING SEQUENCE: CALL TRASYS

ROUTINE NAME: TRNSP

DESCRIPTION: This routine transposes matrix A and stores the result in matrix B.

CALLING SEQUENCE: CALL TRNSP (A, B)

A - Input matrix
B - A^T

ROUTINE NAME: URANUD

DESCRIPTION: This routine defines the parameters necessary to orbit Uranus.

CALLING SEQUENCE: CALL URANUD

KEY VARIABLES:
PRAD - Planet radius
SOL - Solar constant
PALB - Planet albedo factor
WDS - Darkside temperature
WSS - Sun side temperature
GRAV - Gravitational constant

REFERENCES: ORBIT1, ORBIT2

ROUTINE NAME: VENUSD

DESCRIPTION: This routine defines the parameters necessary to orbit Venus.

CALLING SEQUENCE: CALL VENUSD

KEY VARIABLES:
PRAD - Planet radius
SOL - Solar constant
PALB - Albedo factor
WDS - Darkside temperature
WSS - Sun side temperature
GRAV - Gravitational constant

REFERENCES: ORBIT1, ORBIT2

ROUTINE NAME: ZNPMAX

DESCRIPTION: This routine is called from the node plotter (NPLOT) and scales the nodes to be plotted.

CALLING SEQUENCE: ZNPMAX (NNP)

NNP - Number of surface/nodes to be selectively plotted

REFERENCES: NPMAIN, NPCONV

C. FILE DEFINITIONS - PROCESSOR LIBRARY

C. FILE DEFINITIONS - PROCESSOR LIBRARY

FILE NAME: BCDOU

PROGRAM VARIABLE NAME: NBCDOU

UNIT REFERENCE (UNIVAC/JSC): 29

PURPOSE: This file is the output tape for BCD data in the thermal analyzer input format.

SEGMENT REFERENCES: QOCAL (WRITE)
RKCAL (WRITE)
RCCAL (WRITE)

FILE NAME: DI

PROGRAM VARIABLE NAME: NDI

UNIT REFERENCE (UNIVAC/JSC): 10

PURPOSE: This file is for storage of solar, planetary, and albedo direct irradiation data.

SEGMENT REFERENCES: DICAL (WRITE)
RDCAL (WRITE)
AQCAL (READ)
PLOT (READ)

FILE NAME: DIR

PROGRAM VARIABLE NAME: NDIR

UNIT REFERENCE (UNIVAC/JSC): 22

PURPOSE: This file is for storage of direct irradiation data input through the flux data block. It acts as a direct-irradiation restart file.

SEGMENT REFERENCES: DICAL (READ)

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FILE NAME: FF

PROGRAM VARIABLE NAME: NFF

UNIT REFERENCE (UNIVAC/JSC): 9

PURPOSE: This file is used to store form factor data.

SEGMENT REFERENCES: FFCAL (WRITE)
GBCAL (READ)
RBCAL (WRITE)

FILE NAME: FFR

PROGRAM VARIABLE NAME: NFFR

UNIT REFERENCE (UNIVAC/JSC): 21

PURPOSE: This file is used to store form factor data input through the form factor data blocks. It acts as a form factor restart file.

SEGMENT REFERENCES: FFCAL (READ)

FILE NAME: GBIR

PROGRAM VARIABLE NAME: NGBIR

UNIT REFERENCE (UNIVAC/JSC): 11

PURPOSE: This file is for storage of infrared waveband gray-body factor data.

SEGMENT REFERENCES: AQCAL (READ)
GBCAL (WRITE)
ODPROG - Subroutine GBAPRX (WRITE)
RCCAL (READ)
RKCAL (READ)

FILE NAME: GBIRR

PROGRAM VARIABLE NAME: NGBIRR

UNIT REFERENCE (UNIVAC/JSC): 23

PURPOSE: This is the correspondence data storage file.

SEGMENT REFERENCES: RCCAL (READ)
RKCAL (READ)
QOCAL (READ)

FILE NAME: GBSO

PROGRAM VARIABLE NAME: NGBSO

UNIT REFERENCE (UNIVAC/JSC): 12

PURPOSE: This file is for storage of solar-waveband gray-body factor data.

SEGMENT REFERENCES: AQCAL (READ)
GBCAL (WRITE)
ODPROG - Subroutine GBAPRX (WRITE)

FILE NAME: GBSOR

PROGRAM VARIABLE NAME: NGBSOR

UNIT REFERENCE (UNIVAC/JSC): 24

PURPOSE: This file is the solar gray-body factor restart file.

SEGMENT REFERENCES: Not currently used.

FILE NAME: OUTPUT

PROGRAM VARIABLE NAME: NOUT

UNIT REFERENCE (UNIVAC/JSC): 6

PURPOSE: This is the print output file.

SEGMENT REFERENCES: All

FILE NAME: PLS

PROGRAM VARIABLE NAME: NPLS

UNIT REFERENCE (UNIVAC/JSC): 13

PURPOSE: This is used to store the spacecraft/planet form factor matrix and shadow factor data.

SEGMENT REFERENCES: DICAL (READ/WRITE)
SFCAL (READ/WRITE)

FILE NAME: PLSR

PROGRAM VARIABLE NAME: NPLSR

UNIT REFERENCE (UNIVAC/JSC): 25

PURPOSE: This file is the shadow-factor restart file.

SEGMENT REFERENCES: SFCAL (READ)

FILE NAME: PUNCH

PROGRAM VARIABLE NAME: NPUN

UNIT REFERENCE (UNIVAC/JSC): 7

PURPOSE: This file is the punch output file.

SEGMENT REFERENCES: DICAL (WRITE)
FFCAL (WRITE)
RCCAL (WRITE)
RKCAL (WRITE)
QOCAL (WRITE)

FILE NAME: RIO

PROGRAM VARIABLE NAME: NRAN

UNIT REFERENCE (UNIVAC/JSC): 8

PURPOSE: This file is the primary random access file, which is used to store all node and surface description data.

SEGMENT REFERENCES: DICAL (READ)
DRCAL (READ)
FFCAL (READ)
NPLOT (READ)
OPLOT (READ)
RBCAL (READ)

FILE NAME: RSTRO

PROGRAM VARIABLE NAME: NRSO

UNIT REFERENCE (UNIVAC/JSC): 15

PURPOSE: This file serves as the restart output tape.

SEGMENT REFERENCES: Not currently used. File name and unit reserved

FILE NAME: RTO

PROGRAM VARIABLE NAME: NRTO

UNIT REFERENCE (UNIVAC/JSC): 18

PURPOSE: This file is the temporary restart output tape.

SEGMENT REFERENCES: Not currently used. File name and unit reserved

FILE NAME: SHADO

PROGRAM VARIABLE NAME: NSHADO

UNIT REFERENCE (UNIVAC/JSC): 28

PURPOSE: This file is the shadow-factor data output tape.

SEGMENT REFERENCES: SFCAL (WRITE)

FILE NAME: SQNTL

PROGRAM VARIABLE NAME: NSQNTL

UNIT REFERENCE (UNIVAC/JSC): 16

PURPOSE: This file contains pointers for the random access file, plus miscellaneous flags and quantities generated in the preprocessor for use by processor segments.

SEGMENT REFERENCES: RDPROG (READ)

FILE NAME: TAPE1

PROGRAM VARIABLE NAME: NSCR1

UNIT REFERENCE (UNIVAC/JSC): 1

PURPOSE: This file is scratch file 1. Scratch files are never used to pass information between segments.

SEGMENT REFERENCES: GBCAL (READ/WRITE)
RCCAL (READ/WRITE)
RKCAL (READ/WRITE)

FILE NAME: TAPE2

PROGRAM VARIABLE NAME: NSCR2

UNIT REFERENCE (UNIVAC/JSC): 2

PURPOSE: This file is scratch file 2.

SEGMENT REFERENCES: GBCAL (READ/WRITE)
PLOT (READ/WRITE)
QOCAL (READ/WRITE)

FILE NAME: TAPE3

PROGRAM VARIABLE NAME: NSCR3

UNIT REFERENCE (UNIVAC/JSC): 3

PURPOSE: This file is scratch file 3.

SEGMENT REFERENCES: FFCAL (READ/WRITE)
GBCAL (READ/WRITE)
RCCAL (READ/WRITE)

FILE NAME: TQ

PROGRAM VARIABLE NAME: NTQ

UNIT REFERENCE (UNIVAC/JSC): 14

PURPOSE: This file is used for storage of absorbed heat data.

SEGMENT REFERENCES: AQCAL (WRITE)
QOCAL (READ)
PLOT (READ)

FILE NAME: TQR

PROGRAM VARIABLE NAME: NTQR

UNIT REFERENCE (UNIVAC/JSC): 26

PURPOSE: This file is a restart file for absorbed heat data.

SEGMENT REFERENCES: Not currently used. Name and unit reserved

FILE NAME; TRAJ

PROGRAM VARIABLE NAME: NTRAJ

UNIT REFERENCE (UNIVAC/JSC): 4

PURPOSE: This file is used to input trajectory tape data.

SEGMENT REFERENCES: ODPROG - Subroutine DITTP (READ)

FILE NAME: USER1

PROGRAM VARIABLE NAME: NUSER1

UNIT REFERENCE (UNIVAC/JSC): 19

PURPOSE: This is a scratch file reserved for the user.

SEGMENT REFERENCES: User option

FILE NAME: USER2

PROGRAM VARIABLE NAME: NUSER2

UNIT REFERENCE (UNIVAC/JSC): 20

PURPOSE: This is a scratch file reserved for the user.

SEGMENT REFERENCES: User option

D. VARIABLE DEFINITIONS - PROCESSOR LIBRARY

VARIABLE DEFINITIONS - PROCESSOR LIBRARY

D. VARIABLE DEFINITIONS - PROCESSOR LIBRARY

LABELED COMMON /ALPH/

This common block contains an array of nodal absorptivities in the solar waveband.

ALPH - An array of solar absorptivities for active nodes

LABELED COMMON /AQQDP/

This common block provides a storage area in the AQPROG segment for incident planetary fluxes that are read in from the NDI file.

QDP - An array of incident planetary fluxes

LABELED COMMON /AQQDR/

This common block provides a storage area in the AQPROG segment for incident albedo fluxes that are read in from the NDI file.

QDR - An array of incident albedo fluxes

LABELED COMMON /AQQDS/

This common block provides a storage area in the AQPROG segment for incident solar fluxes that are read in from the NDI file.

QDS - An array of incident solar fluxes

LABELED COMMON /AQTEMP/

This common block provides temporary storage in the AQPROG segment for the node array, as read from the NDI file, for verifying correspondence data with the active model node array, NODE.

ITEMP - Temporary array of node numbers

LABELED COMMON /AREA/

This common block contains an array of the active model nodal areas.

AREA - An array of nodal areas

LABELED COMMON /AREAT/

This common block provides a temporary working and storage area for use in the QOPROG segment when combining nodal areas.

AREAT - An array of combined nodal areas

LABELED COMMON /ARRAYS/

This common block is set up by the preprocessor and contains user-input arrays from the Array Data block.

ADUMMY - Integer count of the first array
NAME1 - First user-input array
NAME1 (N) - Integer count of the second array
NAME2 - Second user-input array

LABELED COMMON /BCSN/

This common block contains all the user-input block coordinate system (BCS) names and/or the default BCS name, ALLBLK.

LABELED COMMON /BLKDIR/

This common block contains the block coordinate system directory.

NBLKDR (1, I) - Block coordinate system name
NBLKDR (2, I) - Length of the block data written on the random access record
NBLKDR (3, I) - Random access record number
NBLKDR (4, I) - Flag to indicate whether or not the BCS transformation data have been applied

LABELED COMMON /BLOCK/

This common block contains blocking information used by blank common to invert a matrix when calculating gray-body factors.

NBLCK - Maximum number of blocks into which a matrix may be divided (set by a data statement in GBMAIN)
NBUP - Minimum number of blocks in an upper triangular matrix, as determined by full utilization of blank common
NBLO - Minimum number of blocks in a lower triangular matrix, as determined by full utilization of blank common

LABELED COMMON /CAL28O/

This common block contains plotting information.

XC - The X-coordinate of the point to be plotted in the plotter coordinate system
YC - The Y-coordinate of the point to be plotted in the plotter coordinate system
IP - The index on a computed GO TO statement used in NPFPLT and OPFPLT

LABELED COMMON /CCONST/

This common block contains a collection of constants and variables used throughout the processor.

DIACC - Element selection accuracy factor for node-to-planet form factors

DIACCS - Element selection accuracy factor for direct flux shadowing calculations

DINOSH - Shadow/no shadow flag for direct flux calculations

DIPNCH - Direct flux punch flag

DTR - Conversion factor for degrees to radians

FFACC - Element selection accuracy factor for node-to-node form factor calculations

FFACCS - Element selection accuracy factor for form-factor shadowing calculations

FFMIN - Minimum form factor value to be saved. All form factors smaller than FFMIN are set to zero

FFNOSH - Shadow/no shadow flag for form-factor calculations

FFPNCH - Form-factor punch flag

FFPRNT - Form-factor print flag

FFRATL - Maximum allowable ratio of the maximum number of elements indicated on a node pair divided by the number of elements indicated by arithmetic averaging. If this ratio exceeds FFRATL, the two nodes are temporarily subdivided

GBWBND - Waveband definition for gray-body calculations

IAI - Step number indicating where the IR gray-body factor matrix is to be obtained for flux calculations using the ORBGEN option

IALBFL - Albedo flux compute/stuff flag

IAQGBI - Step number from which IR gray-body factors are to be obtained for absorbed-Q calculations

IAQGBS - Step number from which solar gray-body factors are to be obtained for absorbed-Q calculations

IAQSDA - Step number from which direct albedo fluxes are to be obtained for absorbed-Q calculations

IAQSDP - Step number from which direct planetary fluxes are to be obtained for absorbed-Q calculations

IAQSDS - Step number from which direct solar fluxes are to be obtained for absorbed-Q calculations

IAS - Step number indicating where the solar gray-body factor matrix is to be obtained for flux calculations using the ORBGEN option

IGBSFF - Step number from which form factors are to be obtained for use in gray-body calculations

IMESS - Starting address of the secondary MESS node array

IOVL - Index on a computed GO TO statement set in ODPROG and used in TRASYS. This determines which segment is to be called

IQOARY - Array of step numbers where absorbed-Q data are stored

IQOCOR - Step number from which correspondence data are to be obtained

IQOTAB - Initial array number for the output Qs (= IQOTME + 1)
IQOTME - Output time array number
IPLAFL - Planetary flux compute/stuff flag
IRKCN - Initial radiation conductor number
IRKNGB - Step number from which gray-body factors are to be obtained for use in radiation conductor calculations
IRKNSP - Space node number
ISOLFL - Solar flux compute/stuff flag
ISPND - Starting address of the primary MESS node array
ITRALL - Not used
ITRCAO - Trace flag for the AQPROG segment
ITRCBO - Trace flag for the QOPROG segment
ITRCCO - Trace flag for the RBPROG segment (not used)
ITRCDO - Trace flag for the PLPROG segment
ITRC10 - Trace flag for routines FINDST and STORE
ITRC20 - Trace flag for BUILDC
ITRC30 - Trace flag for the FFPROG segment (not used)
ITRC40 - Trace flag for the SFPROG segment (not used)
ITRC50 - Trace flag for the NPPROG and RCPROG segments
ITRC60 - Trace flag used to print the original radiation conductors in the RCPROG segment
ITRC70 - Trace flag for the DIPROG segment
ITRC80 - Trace flag for the gray-body calculations
ITRC90 - Trace flag for the RKPROG segment
MAXBC - Length of blank common
NBCDSK - Not used
NBLKLN - Number of block coordinate systems in the model
NERN - Effective radiation node number
NMESS - Number of MESS node pairs
NN - Total number of nodes defined by BUILDC/ADD
NNOD - Number of active nodes in the model
NS - Total number of surfaces defined by BUILDC/ADD
NSFO - Configuration name to be used to identify the file when writing the shadow-factor output tape (SHADO)
NSFT - Configuration name to identify the desired file on the shadow-factor input tape (SHADI)
NSPND - Number of MESS node pairs plus the number of special nodes
NSSTEP - Sequence number of the current substep
NSTEP - Sequence number of the current step
NSTPL - Step number indicating where planetary fluxes are to be obtained for a planet-oriented case using the ORBGEN option
NSTSOL - Step number indicating where solar fluxes are to be obtained for a sun-oriented case using the ORBGEN option
NSURF - Number of active shadowing surfaces in the model
PI - The constant π
QOAMPF - Area multiplying factor for the output Qs
QOFMPF - Energy multiplying factor for the output Qs
QOPNCH - Flag to punch the output Qs
QORMPF - Not used
QOTAPE - Flag to write the output Qs on a BCD tape

QOTMPF - Time multiplying factor
QOTYPE - Flag to output the Q tables, the orbital average Q, or both
RALB - Multiplying factor for the absorbed albedo heat
RFRAC - Significant radiation fraction used in the RCPROG segment
RKAMPF - Area multiplying factor used in the RKPROG and RCPROG segments
RKMIN - Minimum value of $\mathscr{F}/\varepsilon$ that will result in a valid radiation conductor
RKPNCH - Radiation conductor punch flag
RKSP - Flag for calculating radiation conductors to space
RKTAPE - Flag to write radiation conductors to the BCD tape
RPLAN - Multiplying factor for the absorbed planetary heat
RSOLAR - Multiplying factor for the absorbed solar heat
RTD - Conversion factor for radians to degrees
SIGMA - Stefan-Boltzmann constant
TRUANF - True anomaly of the final point in the orbit as defined using the ORBGEN option
TRUANI - True anomaly of the first point in the orbit as defined using the ORBGEN option

LABELED COMMON /DIMS/

This common block contains an array of position vectors for shadowing surfaces.

DIMS - Position vector locating the origin of the shadowing-surface coordinate system in the central coordinate system

LABELED COMMON /DIRCT/

This common block contains the translation and rotation information relating a block coordinate system (BCS) to the central coordinate system (CCS), as well as a directory of random-access record numbers for the surfaces in the BCS.

DIRCT (1) - X-component of the translation vector
DIRCT (2) - Y-component of the translation vector
DIRCT (3) - Z-component of the translation vector
DIRCT (4) - Rotation about the CCS X-axis
DIRCT (5) - Rotation about the CCS Y-axis
DIRCT (6) - Rotation about the CCS Z-axis
DIRCT (7) -
DIRCT (8) - Order of rotation about the CCS X-, Y-, Z-axes,
DIRCT (9) - respectively
DIRCT (10) -
⋮ - Random-access record numbers
⋮ -
⋮

LABELED COMMON /DISUR1/

This common block is used to store surface data read in from the random-access file in the DIPROG segment

COMM1 - Five 6-character words describing the surface
CSHDI - Can-shade flag
DATAI - Array of the five surface description parameters, ALPHA, BMIN, BMAX, GMIN, and GMAX
DTEI - Date of the run
DUMI (16) - Dummy array
ILKI - Identifier for type of surface
INOD - Can-be-shaded flag
KSI - Sequence number of surface
NRMASS (1) - Surface ID number
OLDAI - Surface area
POSNI - Position vector locating the center of the encompassing sphere in the CCS

PROPI - Array of surface optical properties: solar absorptivity (ALPH), infrared emissivity (EMISS), infrared transmissivity (TIR), and solar transmissivity (TSO)

RADI - Radius of the preshadowing sphere encompassing the surface

RXI -
RYI - Components of the position vector locating the origin of
RZI - the SCS in the CCS

SPRII - Specular reflectance of the surface in the IR waveband

SPRSI - Specular reflectance of the surface in the solar waveband

TRANI - Transformation Matrix relating the SCS to the CCS

LABELED COMMON /DRQDP/

This common block provides a storage area in the DRCAL segment for incident planetary fluxes that are read in from the NDI file.

QDP - An array of incident planetary fluxes

LABELED COMMON /DRQDR/

This common block provides a storage area in the DRPROG segment for incident albedo fluxes that are read in from the NDI file.

QDR – An array of incident albedo fluxes

LABELED COMMON /DRQDS/

This common block provides a storage area in the DRPROG segment for incident solar fluxes that are read in from the NDI file.

QDS - An array of incident solar fluxes

LABELED COMMON /DRSHDC/

This common block is used to store the sequence numbers of possible shadowing surfaces in the preshadowing calculations of segment DRCAL.

ISHAD - An array of sequence numbers of possible shadowing surfaces

LABELED COMMON /DRSUN/

This common block contains information used in calculating the incident solar flux on a node in the DRPROG segment.

FACT - Unshadowed solar flux on a node
Y - Square of the distance from the node to the sun
Z - Ratio of the solar constant to the node-to-sun distance

LABELED COMMON /DRSUR1/

This common block serves the same purpose in the DRPROG segment that DISUR1 serves in the DIPROG segment (see the DISUR1 description).

LABELED COMMON /DRTRAN/

This common block contains the matrix of direction cosines necessary to transform vectors defined in the planet-oriented vehicle coordinate system to vectors in the user-defined vehicle coordinate system.

PLDC - Transformation matrix

LABELED COMMON /DRTRSH/

This common block contains miscellaneous variables used to calculate incident fluxes in the DRPROG segment.

IN - Sequence number of the current node
NCHECK - Not used
NELT - Total number of elements used on the node
NSHAD - Number of possible shadowing surfaces
NSHADR - Not used
SFAVT - Temporary array of elemental surface area vectors
SFPVT - Temporary array of elemental surface position vectors
SHADS - Shadow factor
SUNPVT - Temporary sun position vector

LABELED COMMON /DRVCTR/

This common block contains vector information for use in calculating incident fluxes in the DRPROG segment.

NEPT - Not used
NEST - Optimum number of elements used on the node
SUNPV - Sun position vector
SFAV - Array of elemental surface area vectors
SFPV - Array of elemental surface position vectors

LABELED COMMON /DSTORE/

This common block contains information used in storing and retrieving data from units assigned to TRASYS.

IDSTR (I, 1) - Unit identifier (NUNIT)
IDSTR (I, 2) - Number of files written to NUNIT
IDSTR (I, 3) - Yes/no flag indicating whether or not the unit has been repositioned

LABELED COMMON /DSTR/

This common block contains surface description data for shadowing surfaces.

DSTR (1, I) - ALPHA
DSTR (2, I) - BMIN
DSTR (3, I) - BMAX
DSTR (4, I) - GMIN
DSTR (5, I) - GMAX

LABELED COMMON /EMISS/

This common block contains IR emissivities.

EMISS - Array of IR emissivities for the active nodes

LABELED COMMON /FA/

This common block contains one row of a symmetric matrix.

FA - Area-form factor product, or area-script F product

LABELED COMMON /FFDAT1/

This common block contains miscellaneous variables used in the FFCAL segment.

FANS - Unshadowed solar form factor
FENS - Unshadowed IR form factor
IABTME - Abort flag set when maximum number of elements per node is exceeded
ICALTP - Flag indicating whether the form factors came from cards, tape, were calculated, or were equivalenced
IEOFFR - End-of-file flag on unit NFFR
IN - Sequence number of the current "looker" node
JN - Sequence number of the current "lookee" node
KTAE - Not used
NEX - Flag to indicate when nodes have been divided into sub nodes
TIMEE - Time at the beginning of the row calculation
TIMET - Time at the beginning of the form-factor calculations
TPER - Not used

LABELED COMMON /FFEQ/

This common block contains the master index for the random-access file (NSCR3) used in equivalenced form factors.

INDXF - Master index

LABELED COMMON /FFSHDC/

This common block serves the same purpose in the FFPROG segment as DRSHDC serves in the DRPROG segment (see the DRSHDC description).

LABELED COMMON /FFSUMC/

This common block contains form-factor sums.

SUM - An array of form-factor sums

LABELED COMMON /FFVALI/

This common block contains a row of IR area-form factor products.

FFVALI - IR area-form factor products

LABELED COMMON /FFVALS/

This common block contains a row of solar area-form factor products.

FFVALS - Solar area-form factor products

LABELED COMMON /GBIR/

This common block contains a row of IR gray-body factors for use in the AQCAL segment.

GBIR - IR gray-body factors

LABELED COMMON /GBSO/

This common block contains a row of solar gray-body factors for use in the AQPROG segment.

GBSO - Solar gray-body factors

LABELED COMMON /IFS/

This common block contains an array of sequence numbers for shadowing surfaces.

IFS - Shadowing-surface sequence numbers

LABELED COMMON /IKS/

This common block contains an array of surface-type identifiers for shadowing surfaces.

IKS - Type of shadowing surface

LABELED COMMON /INDX/

This common block contains the master index for the random-access file NRAN.

INDX - Master index

LABELED COMMON /INDXN/

This common block contains an array of random-access record numbers for active nodes.

INDXN - Array of random-access record numbers for active nodes

LABELED COMMON /INDXS/

This common block contains an array of random-access record numbers for active surfaces.

INDXS - Array of random-access record numbers for active surfaces

LABELED COMMON /ISHAD/

This common block serves the same purpose in the DIPROG segment as DRSHDC serves in the DRPROG segment (see the DRSHDC description).

LABELED COMMON /ISPEC/

This common block contains an array of active specular-surface sequence numbers.

ISPEC - Array of sequence numbers of active specular surfaces

LABELED COMMON /ISPN/

This common block contains an array of primary MESS nodes and/or special nodes for use in the RCPROG segment.

ISPN - Array of primary MESS nodes and/or special nodes

LABELED COMMON /ISTPDR/

This common block contains a directory of user-assigned step numbers.

ISTPDR - Array of user-assigned step numbers

LABELED COMMON /JSURF/

This common block contains an array of all surface numbers defined by BUILDC/ADD.

JSURF - Array of surface numbers

LABELED COMMON /MNP/

This common block contains a list of selected nodes to be plotted in the NPPROG segment.

MNP - Array of selected node numbers to be plotted

LABELED COMMON /MSND/

This common block contains an array of secondary MESS node numbers for use in the RCPROG segment.

MSND - Array of secondary MESS node numbers

LABELED COMMON /MSP/

This common block contains a list of selected surfaces to be plotted in the OPPROG segment.

MSP - Array of selected surface numbers to be plotted

LABELED COMMON /NCONST/

This common block contains miscellaneous variables for use in the NPPROG segment.

ITITLE - Title to be written on each plot frame
KC - Flag indicating which view is to be plotted
KERR - Scaling error flag
NOMI Values to indicate the order of rotation of the plotter
NPHI - coordinate system through the angles OMI, PHI, and PSI,
NPSI respectively
OMI - Angle of rotation of the plotter coordinate system (PCS) about the X-axis
PHI - Angle of rotation of the PCS about the Z-axis
PSI - Angle of rotation of the PCS about the Y-axis
SCL - Scale factor for plotting
VROT - Transformation matrix of direction cosines resulting from the rotations PHI, PSI, and OMI. Transforms vectors in the PCS to the user-defined view

LABELED COMMON /NDS/

This common block is used in the RCPROG segment for temporarily storing node numbers.

NODET - Temporary node array

LABELED COMMON /NODE/

This common block contains an array of the active node numbers.

NODE - Array of active node numbers

LABELED COMMON /NOROLO/

This common block contains information pertinent to partitioning a lower triangular matrix for use in the GBPROG segment.

NLO (1, I) - Number of rows in block I
NLO (2, I) - Number of elements in block I

LABELED COMMON /NOROUP/

This common block contains information pertinent to partitioning an upper triangular matrix for use in the GBPROG segment.

NUP (1, I) - Number of rows in block I
NUP (2, I) - Number of elements in block I

LABELED COMMON /NPMASS/

This common block is used to store surface data read in from the random-access file in the NPPROG segment.

CC - Transformation matrix relating the SCS to the CCS
DATA - Array of the five surface description parameters, ALPHA, BMIN, BMAX, GMIN, and GMAX
ILK - Identifier for type of surface
RMASS - Dummy array of 11 words
RX -
RY - Components of the position vector locating the origin of
RZ - the SCS in the CCS

LABELED COMMON /NSPEC/

This common block contains the number of active specular surfaces.

NSPEC - Number of active specular surfaces

LABELED COMMON /OCONST/

This common block serves the same purpose in the OPPROG segment as NCONST serves in the NPPROG segment (see the NCONST description), except for SCL and the addition of two variables.

RPLN - Planet radius in plot frame dimensions
SCL - Maximum spacecraft dimension, measured from the CCS origin, in plot frame dimensions
SCLR - Orbit radius in plot frame dimensions

LABELED COMMON /ODTEMP/

This common block provides a scratch array available to the programmer within any given segment.

ODTEMP - Scratch array dimensioned to the maximum of 100 and the total number of nodes input in the Surface Data block

LABELED COMMON /OPMASS/

This common block serves the same purpose in the OPPROG segment as NPMASS serves in the NPPROG segment (see the NPMASS description)

LABELED COMMON /OPTRAN/

This common block contains variables used in the OPPROG segment.

S - Transformation matrix to locate the solar position vector in the plotter coordinate system

CTR - Transformation matrix to transform vectors in the CCS to vectors in the orbit coordinate system (OCS)

XV -
YV - Components of the vehicle position vector in the OCS
ZV -

LABELED COMMON /ORBIT/

This labeled common contains all variables associated with orbit definition and other orbit-associated parameters.

ALAN - Longitude of the ascending node
ASUN - Not used
BETA - Angle from the Z_0-axis of the orbit coordinate system to the sun vector (vertex at planet center)
CIGMA - angle, in the orbital plane, from periapsis to the projection of the solar vector in the direction of the spacecraft's motion
CLOCK - Clock angle to the spin vector
CONE - Cone angle to the spin vector
DWP - Subsolar planet emissive power, less the darkside emmissive power
ECC - Orbit eccentricity
GRAV - Planet gravitational constant
HA - Altitude of apoapsis
HP - Altitude of periapsis
ICALFL - Not used
INSHAD - Flag indicating whether the point is in or out of the planet shadow
IORBIT - Flag for type of orbit
= 1 Orbiting the planet
= 2 Orbiting the sun
IORNT - Spacecraft orientation flag
= 1 Planet
= 2 Sun
= 3 Star
= 4 Tape
IROTX - Order of performing rotation ROTX (1, 2, or 3)
IROTY - Order of performing rotation ROTY (1, 2, or 3)
IROTZ - Order of performing rotation ROTZ (1, 2, or 3)
ISFT - Flag directing the use of shadow factor data
ISKPSO - Not used
NSPFF - Step number for storing the spacecraft-to-planet form factors
OINC - Orbit inclination
ORNT - Transformation matrix from the vehicle coordinate system to the central coordinate system
PALB - Planet albedo (solar reflectivity)
PERIOD - Orbital period
PLCL - Clock angle-to-planet position vector (in the CCS)
PLCO - Cone angle-to-planet position vector (in the CCS)
PLTYPE - Spacecraft-planet form factor read/store flag
PNAME - Name of planet being orbited
PRAD - Planet radius
PSD - Planet-sun distance (set to 1.0E + 15 for planetary orbits)
RATE - Spin rate

ROTX - Rotation about the X-axis from the VCS into the CCS

ROTY - Rotation about the Y-axis from the VCS into the CCS

ROTZ - Rotation about the Z-axis from the VCS into the CCS

RSUN - Radius of sun

RTHET - Geocentric altitude

SHADIN - True anomaly when entering the planet shadow

SHAOUT - True anomaly when leaving the planet shadow

SOL - Solar "constant"

SPINT - Transformation matrix from the CCS at zero spin time to the CCS at the current spin time

STRRA - Right ascension of star

STRDEC - Declination of star

SUNCO - Cone angle to sun vector (in the CCS)

SUNCL - Clock angle to sun vector (in the CCS)

SUNDEC - Declination of the sun

SUNRA - Right ascension of the sun

TIMEPR - Current problem time

TIMEST - Time of periapsis passage

TIMSP - Time at which spinning begins

TRUEAN - Orbit true anomaly

WSS - Subsolar emissive power of the planet

WSUN - Emissive power of the sun

LABELED COMMON /PLANET/

This common block contains variables used to compute the planet/spacecraft geometry relationship and the planet element breakdown.

ALB - Product of the planet radius and BETPM

ALG = AREAPL/ALB

APEAPL - Area of the portion of the planet visible from the spacecraft

BETPM - Angular measurement from the subspacecraft point on the planet to the planet horizon, with the center of the planet as the vertex

E = (PRAD + H)*PRAD
where:
PRAD = Planet radius
H = Altitude of spacecraft

POSP - Components of a vector from the CCS origin to the center of the planet

RADP - Radius of a preshadowing sphere associated with a planet element

RADPJ - Array containing radii of the preshadowing spheres associated with each planet element

LABELED COMMON /PR/

A 2xNS array containing the IR and solar transmissivities associated with each surface.

PR (1, N) - IR Transmissivity of surface N
PR (2, N) - Solar transmissivity of surface N

LABELED COMMON /PSH/

A 4xNS array containing data associated with the preshadowing sphere for each surface.

PSH (1, N) - Radius of the preshadowing sphere for surface N
PSH (2, N) -
PSH (3, N) - Components of the position vector to the center of
PSH (4, N) - the preshadowing sphere for surface N

LABELED COMMON /QAP/

This labeled common contains an array of absorbed planetary heat rates for each node.

QAP (N) - Absorbed planetary heat rate (energy/unit time) for node N

LABELED COMMON /QAR/

This labeled common contains an array of absorbed reflected (planetary albedo) heat rates for each node.

QAR (N) - Absorbed albedo heat rate (energy/unit time) for node N

LABELED COMMON /QAS/

This labeled common contains an array of absorbed solar heat rates for each node.

QAS (N) - Absorbed solar heat rate (energy/unit time) for node N

LABELED COMMON /PLOT/

This common block contains arrays of information used in the NPPROG and OPPROG segments.

IOPNNP - An array that is functionally analogous to NPNNP for use in the OPPROG segment

IOPNV - Not used

IOPTIT - An array that is functionally analogous to NPTIT for use in the OPPROG segment

IOPVU - An array of views to be plotted in the OPPROG segment

NPNNP - An array of starting locations in labeled common ARRAYS for user-input arrays of selected nodes to be plotted in the NPPROG segment

NPTIT - An array of starting locations in labeled common ARRAYS for user-input title arrays that are to be written on plot frames in the NPPROG segment

NPVU - An array of views to be plotted in the NPPROG segment

OPROT - An array of user-input Euler angles for general views in the OPPROG segment

OPRPLN - An array of the desired plot sizes of the planet radius for use in the OPPROG segment

OPSCL - An array specifying the desired plot size for maximum spacecraft dimensions, as measured from the CCS origin for use in the OPPROG segment

OPSCLR - An array specifying the desired plot sizes of the orbit radius for use in the OPPROG segment

OPTIMP - An array of present times in the orbit used in conjunction with OPTIMS to calculate true anomalies in the OPPROG segment

OPTIMS - An array of perigee passage times for use in the OPPROG segment

OPTRUE - An array of true anomalies for use in the OPPROG segment

ZNPROT - An array of user-input Euler angles for general views in the NPPROG segment

ZNPSCL - An array of scale factors for use in the NPPROG segment

LABELED COMMON /PLOTTR/

This labeled common contains the variables, flags, and Hollerith title data for controlling data plot operations.

IPLNA - Array of node numbers for selective data plotting

IPLSN - Array of step numbers for selective data plotting

IPLUNT - Plot flag for type of data

PLCRVF - Yes-no flag for curve fitting data plots

PLLABX - X-axis plot label array

PLLABY - Y-axis plot label array

PLTIT1 - Plot label title 1

PLTIT2 - Plot label title 2

PLXMPF - Plot multiplying factor for X-axis

PLYMPF - Plot multiplying factor for Y-axis

LABELED COMMON /QAVERG/

This labeled common contains an array of orbital average absorbed total heat rates for each node.

QAVERG (N) - Average absorbed heat rate for node N

LABELED COMMON /QDP/

This labeled common contains an array of direct planetary heat fluxes for each node.

QDP (N) - Direct planetary heat flux (energy/unit time/unit area)
for node N

LABELED COMMON /QDR/

This labeled common contains an array of reflected (planetary albedo heat fluxes for each node.

LABELED COMMON /QDS/

This labeled common contains an array of solar heat fluxes for each node.

LABELED COMMON /QOCMB/

This labeled common contains an array used for working storage of correspondence data when combining absorbed-Q data for output.

ICOMB - a. An array of node numbers identical with the list on the right side of an equal sign in correspondence data
b. On the second pass of the combining logic, node numbers duplicated in the correspondence data are set negative

LABELED COMMON /QOFRST/

This labeled common contains an array of pointers that refer to node numbers duplicated in the correspondence data.

IFRST - An array of sequence numbers pointing to node numbers on the left side of equal signs in the correspondence data that are duplicated by node numbers on the right of any equal sign

LABELED COMMON /QONODT/

This labeled common contains a temporary-node-number array.

NODET - A temporary-node-number array used in node combining operations. Combine operations begin in a manner identical to those in the NODE (uncombined) array and end as a combined node array

LABELED COMMON /RBDAT1/

This common block serves the same purpose in the RBPROG segment that FFDAT1 serves in the FFPROG segment (see the FFDAT1 description).

LABELED COMMON /RBFFVI/

This common block contains a row of IR area-form factor products that were read in from the NSCR1 file or the NFFR file.

FFVALI - IR area-form factor products

LABELED COMMON /RBFFVS/

This common block contains a row of solar area-form factor products that were read in from the NSCR1 file or the NFFR file.

FFVALS - Solar area-form factor products

LABELED COMMON /RBSHDC/

This common block serves the same purpose in the RBPROG segment as DRSHDC serves in the DRPROG segment (see the DRSHDC description).

LABELED COMMONS /RBSUR1/ and /RBSUR2/

These common blocks serve the same purpose in the RBPROG segment as DISUR1 serves in the DIPROG segment (see the DISUR1 description).

LABELED COMMON /RBVALI/

This common block contains a row of IR area-image factor products.

RBVALI - IR area-image factor products

LABELED COMMON /RBVALS/

This common block contains a row of solar area-image factor products.

RBVALS - Solar area-image factor products

LABELED COMMON /RKCMB/

This common block serves the same purpose in the RKPROG segment as QOCMB serves in the QOPROG segment (see the QOCMB description).

LABELED COMMON /RKFRST/

This common block serves the same purpose in the RKPROG segment as QOFRST serves in the QOPROG segment (see the QDFRST description).

LABELED COMMON /RKNODT/

This common block serves the same purpose in the RKPROG segment as QONODT serves in the QOPROG segment (see the QONODT description).

LABELED COMMONS /RMASS1/ and /RMASS2/

These common blocks serve the same purpose in the FFPROG segment as DISUR1 serves in the DIPROG segment (see the DISUR1 description).

LABELED COMMON /RMASSM/

This common block serves the same purpose in the RBPROG segment as DISUR1 serves in the DIPROG segment (see the DISUR1 description).

LABELED COMMON /RNDMRP/

This common block contains the random-access record numbers and record lengths that are passed from the preprocessor to the processor to enable the processor to access preprocessor-generated data from the random access file. These variables are used in the RDPROG segment to set up processor common blocks.

NLAD - The record length of the user array directory array

NLRIO - The maximum number of records that can exist on the random I/O file

NRAND - The random I/O record number of the user array name directory array

NRAPD - The random I/O record number of the user array position directory array

NRAV, NLAV - The random I/O record number and the record length of the user array value array. Used to set up common ARRAYS

NRBCSD, NLBCSD - The random I/O record number and the record length of the BCS directory

NRBCSN, NLBCSN - The random I/O record number and the record length of the BCS name array. Used to set up common BCSN

NRBCSR, NLBCSR - The random I/O record number and the record length of the BCS index. Used to set up common BLKDIR

NRCQD, NLCQD - The random I/O record number and the record length of the control constants directory array

NRCQV, NLCQV - The random I/O record number and the record length of the control constants value array. Used to set up common CCONST

NRIN, NLIN - The random I/O record number and the record length of the node index

NRIS, NLIS - The random I/O record number and the record length of the surface index

NRSD, NLSD - The random I/O record number and the record length of the step directory. Used to set up common ISTPDR

NRT, NLT - The random I/O record number and the record length for the title array. Used to set up common TITLE

NRTD, NLTD - The random I/O record number and the record length of the combined directory

NRUQD, NLUQD - The random I/O record number and the record length of the user constant directory array

NRUQV, NLUQV - The random I/O record number and the record length of the user constant value array. Used to set up common UCONST

LABELED COMMON /SF/

This labeled common contains a storage array for script-F (gray-body factor) data.

SF - An array used to store one row of script-F values during node-combining operations in the RKPROG segment

LABELED COMMON /SFS/

This labeled common contains a storage array for script-F data.

SFS - An array used to store one row of script-F values during node-combining operations in the RCPROG segment

LABELED COMMON /SFSHDC/

This labeled common used in the SFPROG segment in same manner as labeled common DRSHDC in DRPROG.

LABELED COMMON /SFQDP/

Not used

LABELED COMMON /SFQDR/

Not used

LABELED COMMON /SFQDS/

Not used

LABELED COMMON /SFSUR1/

This labeled common contains the same variable names and is used identically with labeled common DISUR1.

LABELED COMMON /SFVECC/

This labeled common contains variables used to define surface and planet elements used in shadow-factor tape calculations.

NEPT - Number of elements on the planet
NEST - Number of elements on the node
PLAV - Planet-element area vector array (3 components in the CCS for each element)
PLPV - Planet-element position vector array
SFAV - Surface-element area vector array
SFPV - Surface-element position vector array
SUNPV - Sun position vector

LABELED COMMON /SPACE/

This labeled common contains an array of script-F (gray-body) factors from each node to space.

LABELED COMMON /SPACNO/

This labeled common contains radiation conductor values from each *combined* node to space, and is used in the RKPROG segment.

LABELED COMMON /SPCNO/

This labeled common, used in RCPROG, is exactly analogous to SPACNO.

LABELED COMMON /SREFLI/

This common block contains an array of surface IR specular reflectivities used in the DRPROG and RBPROG segments.

SREFLI - Array of IR specular reflectivities for active specular surfaces

LABELED COMMON /SREFLS/

This common block contains an array of surface solar specular reflectivities used in the DRPROG and RBPROG segments.

SREFLS - Array of solar specular reflectivities for active specular surfaces

LABELED COMMON /SRIR/

This common block contains an array of nodal IR specular reflectivities used in the DRPROG and the RBPROG segments.

SRIR - Array of IR specular reflectivities for active nodes

LABELED COMMON /SRSO/

This common block contains an array of nodal solar specular reflectivities used in the DRPROG and the RBPROG segments.

SRSO - Array of solar specular reflectivities for active nodes

LABELED COMMON /SUN/

This labeled common is identical to labeled common DRSUN.

LABELED COMMON /TAPE/

This labeled common contains all variable names for the processor library files (see Section III-C).

LABELED COMMON /TITLE/

This labeled common contains title information.

TITLE - Problem title input by the user
NTITLE - Title identifying the segment in the segment header printouts

LABELED COMMON /TRANS/

This labeled common contains a transformation matrix to transform planet-oriented vectors to the user-defined VCS.

PLDC - Transformation matrix used to transform vectors from a planet-centered coordinate system to the VCS

LABELED COMMON /TRASH/

This labeled common contains miscellaneous vector arrays and variables used in direct flux calculations.

IN - Current-node sequence number
NCHECK - Check flag to eliminate unnecessary calls to the preshadowing routine
NELT - Temporary storage address for the number of elements on a node during element optimization operations
NSHAD - Number of possible shadowing surfaces associated with a node
PLAVT - Temporary storage address for planet-element area vectors
PLPVT - Temporary storage address for planet-element position vectors
SFAVT - Temporary storage address for node-element area vectors
SFPVT - Temporary storage address for node-element position vectors
SUNPVT - Temporary storage address for the sun position vector

LABELED COMMON /TRIR/

This common block contains an array of nodal IR transmissivities.

TRIR - Array of IR transmissivities for active nodes

LABELED COMMON /TRSO/

This common block contains an array of nodal solar specular transmissivities.

TRSO - Array of solar transmissivities for active nodes

LABELED COMMON /TSTR/

This common block contains an array of transformation matrices for shadowing surfaces.

TSTR - Array of transformation matrices relating the SCS coordinates of shadowing surfaces to the CCS

LABELED COMMON /UCONST/

This array contains user-defined constants that were input in the Quantities Data block.

LABELED COMMON /VARBL/

This common block contains variables used to calculate albedo and planetary fluxes in the DIPROG segment.

ALBF - Product of the solar constant and form factor from an insolated planetary element to the sun
PLNF - Emissive power of a planetary element

LABELED COMMON /VECTOR/

This labeled common contains the same variable names, used in the same way as those in labeled common SFVECC.

LABELED COMMON /XSPACE/

This labeled common contains a scratch array used to store one row of the inverted gray-body factor matrix.

BLANK COMMON

Blank common in the TRASYS processor is used as a scratch storage area in central memory.