NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS 77058

REPLY TO
ATTN OF: EG2-71-34

FEB 04 1971

MEMORANDUM TO: FS/Acting Chief, Flight Support Division

FROM : EG/Chief, Guidance and Control Division

SUBJECT : Fixed memory constants in COLOSSUS 2E and LUMINARY 1D

Reference is made to memorandum 71-FS55-2, dated January 8, 1971, and TRW IOC 71:7254.5-12, dated January 21, 1971.

The first reference requested a review of flight program constants related to the DAP's, and to indicate where probable discrepancies exist. This review has been performed and results appear in reference 2. These constants are adequate for Apollo 14, but require a more extensive review prior to rope manufacture for J series Lunar Modules. It is requested that MIT/DL reassess LM DAP design adequacy for the heavier LM, and this Division will also spend some additional effort on validation of these numbers for Apollo J series vehicles.

R G Chilton
Robert G. Chilton

cc:
EA/M. A. Faget
EA2/R. A. Gardiner
EG/D. C. Cheatham
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FA/S. A. Sjoberg
H. W. Tindall, Jr.
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FM/J. P. Mayer
FS/H. E. Leech
FS2/J. M. Satterfield
FS4/S. D. Sanborn
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EG2:WHPeters:dbb 2-1-71

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS 77058

REPLY TO
ATTN OF: 71-FS55-2

JAN 08 1971

MEMORANDUM TO: EG/Chief, Guidance and Control Division

FROM : FS/Acting Chief, Flight Support Division

SUBJECT : Review of hardware dependent constants used in the Digital Auto Pilots for the COLOSSUS and LUMINARY programs

The enclosures to this memorandum contain lists of hardware dependent constants prepared by MIT/SDL from COLOSSUS 2E and LUMINARY 1D programs. It is requested that Guidance and Control Division undertake a review of the Digital Auto Pilot constants in these lists and notify the Flight Support Division where possible discrepancies exist.

James C. Stokes, Jr.

Enclosures 2

cc:
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FS55:GRSabionski:beb

Massachusetts Institute of Technology
Charles Stark Draper Laboratory

Colossus Memo 304

TO: Distribution
FROM: Harry McOuat
DATE: 4 January 1971
SUBJECT: Fixed memory hardware related constants in Colossus 2E.

Attached is a list of fixed hardware related constants in Colossus 2E (COMANCHE, Rev 108). This list was arrived at by first using a program to strip out all constants which might possibly be hardware related, and then preforming a visual perusal of the resulting list and pertinent documentation (GSOP's, Flow Charts, etc.) to ascertain those constants which seem to be hardware related. The attached list has been reviewed by individuals in the various divisions of 23.

This list of constants may still be deficient in that there are many numbers which are hardware connected but are "insensitive" to the stripping process, such as the time lag programmed via TC FIXDELAY where the ΔT is associated with shaping the frequency response of a hardware loop.

It is likely that the list also constains many constants which are not needed but are included "just to be safe".

In the interest of improving this list for Colossus 2E and also for Colossus 3 and Skylab, all comments are welcomed. Perhaps a set of rules should be generated for labeling constants go/no go so that this will become a normal fall out of program development rather than an "after the fact" collection.

Massachusetts Institute of Technology
Charles Stark Draper Laboratory

Luminary Memo 191

TO: Distribution
FROM: Harry McOuat
DATE: 4 January 1971
SUBJECT: Fixed memory hardware related constants in Luminary 1D.

Attached is a list of fixed hardware related constants in Luminary 1D (Luminary 178). This list was arrived at by first using a program to strip out all constants which might possibly be hardware related, and then performing a visual perusal of the resulting list and pertinent documentation. (GSOP's, Flow Charts, etc.) to ascertain those constants which seem to be hardware related. The attached list has been reviewed by individuals in the various divisions of 23.

This list of constants may still be deficient in that there are many numbers which are hardware connected but are "insensitive" to the stripping process, such as the time lag programmed via TC FIXDELAY where the ΔT is associated with shaping the frequency response of a hardware loop.

It is likely that the list also contains many constants which are not needed but are included "just to be safe".

In the interest of improving this list for Luminary 1D and Luminary 1E, all comments are welcomed. Perhaps a set of rules should be generated for labeling constants go/no go so that this will become a normal fall out of program development rather than an "after the fact" collection.

EA WLS

TRW
SYSTEMS GROUP

INTEROFFICE CORRESPONDENCE 71:7254.5-12

TO Task E-72C File CC: Distribution DATE: 1-21-71

SUBJECT: Review of DAP-Related Fixed Memory Constants for LUMINARY 178 and COLOSSUS 108 Programs

FROM: R. Lee
N. P. Dwivedi
R. L. Haken
BLDG. H-4 ROOM 2017 EXT. 32
H-4 2009 23

References:

1. MIT/SDL COLOSSUS Memo 304, "Fixed Memory Hardware Related Constants in COLOSSUS 2E," dated 4 January 1971.

2. MIT/SDL LUMINARY Memo 191, "Fixed Memory Hardware Related Constants in LUMINARY 1D," dated 4 January 1971.

3. MSC 71-Fs55-2, "Review of Hardware Dependent Constants used in the Digital Autopilots for the COLOSSUS and LUMINARY Programs," dated 8 January 1971.

4. Assemble Revision 108 of AGC Program Comanche by NASA 2021113-091, dated 26 May 1970.

5. Assemble Revision 178 of AGC Program LUMINARY by NASA 2021112-151, dated 31 August 1971.

INTRODUCTION

MIT/SDL published lists of hardware-related fixed memory constants for the LUMINARY 178 and COLOSSUS 108 Programs (References 1 and 2). In response to an action item (Reference 3), a review of the DAP-related fixed memory constants was initiated. The constants were stripped out of the flight software by a special program and, as References 1 and 2 indicate, all hardware-related constants may not have been extracted. Also, many constants listed are not hardware-related. This study considered only those constants specified in the two lists.

In many cases, a visual inspection of the constant mnemonic was not sufficient to determine whether the constant was DAP-related. In these cases, it was necessary to consult the flight programs (References 4 and 5) for further detail. Hence, many of the non DAP-related constants were reviewed. The final review process consisted of the following steps:

1. Check the listed values of all constants in References 1 and 2 against the flight programs (References 4 and 5).

2. Extract the DAP-related constants.

3. Verify the value of the DAP-related constants with an interpretation of the flight program, the GSOP's, etc.

DISCUSSION

Following the review procedure, several factors were uncovered which complicated this study. A significant number of typographical errors in the spelling of the mnemonics made it difficult to find the constants in the program listings. Although these are trivial errors, these errors are listed in Tables 1 and 4, with the correct mnemonics. Also, the two memoranda listing the constants presented the constant values in various forms, or in some cases, not at all. That is, in some cases, the values represented the stored value or octal representation which corresponded directly to the value in the program listing. In other cases, the equation value was given which represented the program value manipulated with appropriate scale factors. Finally, for some constants which represented a table of values, no values were given. Hence, it was difficult to determine where actual discrepancies existed. For completeness, all inconsistencies are listed in Table 2 and 5. The DAP-related constants are presented in Tables 3 and 6.

The detection of actual discrepancies was difficult due to the numerous transcription errors in the values presented in the MIT memoranda. Also, each difference in values had to be examined to determine whether the listed value was equivalent to the value given in the program listing. Apparent discrepancies are noted by asterisks in Tables 2 and 5.

In response to the call for comments in Reference 1, the list of fixed constar could be improved by having the program strip out the octal values of the constants and print these numbers directly. This will insure consistency in the listed numer ical values and avoid transcription errors. Then a remark column could be added giving the equivalent value of the constant in engineering units. The reference to flow diagrams and GSOP's presented in References 1 and 2 was quite helpful in checking the constants.

TABLE 1

Typographical Errors in Mnemonics of LUMINARY Constants

Incorrect	Correct
FRC34	FRCS4
85DEGS	82DEGS
GEØRGES	GEØRGEJ
RØESGAIN	RDESGAIN
90MSCALE	90MSCALR
CØS60DEGS	CØS60DEG
GUIDBURN	GUIDDURN
HCRØFF	HLRØFF
4MAXNØM	4FMAXNØM
PPØSMAX	PRØJMAX
PPØSMIN	PRØJMIN
DEPPCPIT	DEPPCRIT
GSCNE1	GSCALE1
UNFULIM	UNFVLIM
SDEBPASS	5DEGREES
TS/6HT1	TSIGHT1
DEGPRR1	DEGREE1
-6YBØMIN	-GYRØMIN

TABLE 1 (Cont'd)

Incorrect	Correct
6YRØFRAC	GYRØFRAC
NAPRØWDR	NARRØWDB
PØWRDB	PØWERDB
-160MSTG	-160MST6
+150MSTG	+150MST6
SCLNØPM	SCLNØRM
-0.5AT2	-.05AT2
-.75AT2	-.15AT2
TSMIN	TJMIN
-100MSTB	-100MST6
NFG1/J	NEG1/3
ØCT2J146	ØCT23146
1.7071	.7071
TØPQCØNS	TØRQCØNS
MINLMP	MINLMD
ØNESEC	ØNESEK
ØCT770000	ØCT77000
IJACCØN	1JACCCØN
RUFPATE	RUFRATE

TABLE 2

Differences in Listed Values for LUMINARY Constants

Constant	Listed Value	Program Listing
MAXVEL	198.645 B-5 M/CS	OCT 00466
MAXDBITS	300 fps	.01034
* -45DEGSR	OCT 70000	13,14,15
-FØURDT	-800	-800 B-18
1SEC20	100	100 B-14
3.5SEC	350	350 B-13
6SEC	600	600 B-14
89SECS	8900	8900 B-14
6.5SECS	650	650 B-17
HLRØFF	15.24	15.24 B-10
FEXTRA	(NO VALUE GIVEN)	BIT 13
SHFTFACT	1	1 B-17
RIMUZ	99.486	99.486 B-14
±ELBIT	NA	BIT 2, BIT 1
±AZBIT	NA	BIT5, BIT 6
ALL4BITS	NA	00063
* AZEACH	.01746	.03491
* ELEACH	.01746	.00873
PRØJMAX	.42262	.42262 B-3
PROJMIN	.25882	.25882 B-3
HIGHESTF	4.34546769	4.34546769 B-12
GSCALE	100	100 B-11
DEPPCRIT	-.02	-.02 B-1

*APPARENT DISCREPANCIES

TABLE 2 (Continued)

Differences in Listed Values for LUMINARY Constants

Constant	Listed Value	Program Listing
HINJECT	18288	18288 B-24
(TGØ)A	37000	37000 B-17
49FPS	.149352	.149352 B-6
VINJNØM	16.7924	16.7924 B-7
RDØTDNØM	.059436	.059436 B-7
DAXMAX	.11111111111 .01111111111	.11111111111 .0111111111
DAY/2MAX	.05555555555 .00555555555	.05555555555 .0055555555
DELERLIM	0.05555555555 0.00555555555	.05555555555 .0055555555
*TSIGHT1	3600	36000
*GYRØFRAC	.251 B-21	.215 B-21
DACLIMIT	-3848 16000_8 3848	-384_8 16000_8 384_8
.00375A8	$.00375_{10}$	.00375 B-3
DGBF	0.610	0.6_{10}
IJACCCØN	1678	00167_8
TØRQCØNS	$.51433_{10}$	0.51443 B-14

*APPARENT DISCREPANCIES

TABLE 3

LUMINARY 178 DAP CONSTANTS

Mnemonic	Description	Program Value	Equivalent
FDPS	DPS thrust	4.367 B-7	9817.5 lbs
MDØTDPS	DPS flow rate	0.1480 B-3	32.62 lbs/sec
DTDECAY	40% FTP-DPS tailoff for P40	-38	
FAPS	APS thrust	1.5569 B-7	3500 lbs
MDØTAPS	APS flow rate	0.05135 B-3	11.32 lbs/sec
ATDECAY	APS tailoff constant	-18	618 lb-sec
100PCTTØ	100% FTP-DPS tailoff for P70 (DPS abort)	24 B-17	
FRCS4	RCS 4-jet ullage thrust	0.17792 B-7	400 lbs
FRCS2	RCS 2-jet ullage thrust	0.08896 B-7	200 lbs
K1VAL K2VAL K3VAL	APS impulse data for P40	140.12 B-23 31.138 B-24 1.5569 B-10	3150 lb-sec APS impu 700 lb-sec 3500 lbs thrust
S40.136 540.136	DPS 10% thrust	.4671 B-9 .4671 B+1	1050 lbs force
(1/DV)A K(1/DV)	Initial velocity parameter for powered ascent P-12 pre-ignition phase	15.20 B-7 436.7 B-9	
(AT)A	Initial APS thrust in P-12 pre-ignition phase	3.2883 E-4 B+9	
AT/RCS	Acceleration of 4 RCS jets in a dry LM	.0000785 B+10	
APSVEX	APS exhaust velocity	-3030 E-2 B-5	9942 fps
DPSVEX	DPS exhaust velocity	-2.95588868 E+1 B-5	2.456 E+3
TRIMACCL	Thrust acceleration expected during Trim Phase	3.50132708 E-5 B+8	
THRESH1 THRESH3 THRESH2	Threshold values for ΔV monitor in cm/sec	24 12 308	

TABLE 3 (Continued)

LUMINARY 178 DAP CONSTANTS

Mnemonic	Description	Program Value	Equivalent
H1RTHRØT	Zero auto-throttle whenever engine is turned off	BIT 13	
FMAXØDD FMAXPØS	DPS thrust levels for throttle command routine	3841 3467	10,821 lbs 9,767 lbs
THRØTLAG	DPS throttle lag time constant	8	8 cs
SCALEFAC	Scales DPS throttle pulses to lbf	7.97959872 E+2 B-16	2.8173 lbf/pulse
DPSTHRSH	DPS ΔV monitor threshold for LM-alone	36	36 cm/sec
GUIDDURN	Estimated time interval from FTP to t_{LAND}	66440	66440 cs
FEXTRA /AF/CNST 4MAXNØM	DPS Thrust levels used in throttle-command routine	BIT 13 0.13107 14908	11,540 lbf 5E-7 10,500 lbf
NARRØWDB	DAP narrow deadband	OCT 00155	0.2994 deg
WIDEDB	DAP wide deadband	OCT 03434	4.999 deg
PØWERDB	Powered flight deadband	.02222	1 deg
MS100	Set TIME5 to interrupt in 100MS	37766_8	100 ms
DACLIMIT	Limits placed on quantities displayed on FDAI error needles	-384 16000 384	42.1875 deg 10.4976 deg/sec
ØNETENTH	Scale factor used in FDAI displayed quantities	03146	0.10
-ØCT630	Constant used in P-Axis RCS	77147_8	-630
1/10SEC	Mask used for checking bit 1 RCS FLAGS	00001	00001
40CYC	Used as the initial setting for the timing cell for the "direct"manual control mode	00050_8	40
-160MST6	Constant used in PURGENCY in determining number of jets to use	-256_{10}	160 msec

TABLE 3 (Continued)

LUMINARY 178 DAP CONSTANTS

Mnemonic	Description	Program Value	Equivalent
-FØURDEG	Constant used in PURGENCY in determining number of jets to use	$-.08888_{10}$	-3.9996 deg
+150MST6	Constant used in jet on-time calculations	240_{10}	150 msec
-100MS	Constant used in setting jet on-times	-0.1_{10}	100 msec
200MS	Constant used in calculating disturbing accelerations	0.2_{10}	100 msec
25/32	Used for converting from seconds to centiseconds	$.78125_{10}$	25
1/40	Used to convert sensed attitude change data to vehicle rate data	0.025_{10}	100 msec
MINTIMES	Used in setting jet on-times	-22_{10} $+22_{10}$	1.375
60MS	Minimum impulse jet on-time for docked configuration	140_8	60 msec
14MS	Minimum impulse jet on-time for undocked configuration	22_{10}	14 msec
40CYCL	Used as the initial setting for the timing cell for the"direct" manual control mode	50_8	40
LINRAT	Used as the coefficient of the linear term in the quadratic expression for hand controller response	46_{10}	11.5
-150MS	Constant used in setting jet on-times	-240_{10}	150 msec
SENSØR	Used to convert scaling used in "TJETLAW" to that used for TIME6 calculations	14400_8	100

TABLE 3 (Continued)

LUMINARY 178 DAP CONSTANTS

Mnemonic	Description	Program Value	Equivalent
-3DEG	Constant used in determining whether or not FINELAW should be used	-0.06667_{10}	-3 deg
-.0112A8	Constant used in computing jet on-times in ZONE5	-0.0141_{10}	150.2^2 $msec^2$
.1AT4	Constant used in computing jet on-times in ZONE5	0.025_{10}	100 msec
.1AT2	Constant used in computing jet on-times in ZONE1	0.05_{10}	0.2 sec
.0375AT4	Constant used in computing jet on-times in ZONE1	0.00938_{10}	0.03752 sec
-.025AT2	Constant used in computing jet on-times in ZONE1	-0.0125_{10}	50 msec
-0.025AT4	Constant used in computing jet on-times in ZONE5	-0.00625_{10}	25 msec
-.05AT2	Constant used in computing jet on-times in ZONE 5	-0.025_{10}	100 msec
-.15AT2	Constant used in computing jet on-times in ZONE 5	-0.0075	300 msec
.00375A8	Constant used in computing jet on-times in ZONE5	$.00375_{10}$	86.6^2 $msec^2$
-TJMAX	Constant used in testing whether ZONE123 computations should be made	$-.0375_{10}$	150 msec
TJMIN	Lower limit on jet on-time used in ZONE1	$.005_{10}$	20 msec
RUFRATE	Used as a rate limit in TJETLAW phase plane calculations	$.1444_{10}$	6.5 deg/sec
-100MST6	Constant used in RATELOOP calculations	-160_{10}	100 msec
NEG1/3	Constant used in Trim Gimbal Control Algorithm	$-.33333_{10}$	
ØCT23146	Scaling constant used in TIMEGMBL	0.6	0.4

TABLE 3 (Continued)

LUMINARY 178 DAP CONSTANTS

Mnemonic	Description	Program Value	Equivalent
ØCT00240	Conversion factor used in TIMEGMBL	240_8	10 sec^{-1}
ØCT11276	Constant used in computing square root in SCALLOOP	11276_8	
INERCØNA-2	A coefficient in the computation of the proportionality factor between DPS gimbal angle and the moment arm of the thrust around c.g.	.0410511917	21522.647 kg ft/rad
INERCØNA+0	A coefficient in the computation of RCS single jet acceleration	.0059347674	48.6176145 rev sec^{-2} k
INERCØNA+2	A coefficient in the computation of RCS single jet acceleration	.0014979264	12.2710131 rev sec^{-2} k
INERCØNA+4	A coefficient in the computation of RCS single jet acceleration	.0010451889	8.5621875 rev sec^{-2} kg
INERCØNA+6	A coefficient in the computation of RCS single jet acceleration	.0065443852	53.6116036 rev sec^{-2} k
INERCØNA+8	A coefficient in the computation of RCS single jet acceleration	.0035784354	29.3145428 rev sec^{-2} k
INERCONA+10	A coefficient in the computation of RCS single jet acceleration	.0056946631	46.6506801 rev sec^{-2} k
INERCØNB-2	A coefficient in the computation of the proportionality factor between DPS gimbal angle and the moment arm of the thrust around c.g.	.155044	1.240352 ft/rad
INERCØNC-2	A coefficient in the computation of the proportionality factor between DPS gimbal angle and the moment arm of the thrust around c.g.	-.025233	-1653.7 kg
INERCØNC+0	A coefficient in the computation of RCS single jet acceleration	.008721	571.5 kg
INERCØNC+2	A coefficient in the computation of RCS single jet acceleration	-.068163	-4467.1 kg

TABLE 3 (Continued)

LUMINARY 178 DAP CONSTANTS

Mnemonic	Description	Program Value	Equivalent
INERCØNC+4	A coefficient in the computation of RCS single jet acceleration	-.066027	-4327.1 kg
INERCØNC+6	A coefficient in the computation of RCS single jet acceleration	-.006923	-453.7 kg
INERCØNC+8	A coefficient in the computation of RCS single jet acceleration	0.002588	169.6 kg
INERCØNC+10	A coefficient in the computation of RCS single jet acceleration	-.023608	-1547.2
INERCØNB+0	A coefficient in the computation of RCS single jet acceleration	.002989	3.7363×10^{-4} rev/se
INERCØNC+1	A coefficient in the computation of RCS single jet acceleration	.018791	2.3489×10^{-3} rev/se
INERCØNC+3	A coefficient in the computation of RCS single jet acceleration	.021345	2.6681×10^{-3} rev/se
INERCØNC+5	A coefficient in the computation of RCS single jet acceleration	.000032	4.0000×10^{-6} rev/se
INERCØNC+7	A coefficient in the computation of RCS single jet acceleration	.162862	2.0358×10^{-2} rev/se
INERCØNC+9	A coefficient in the computation of RCS single jet acceleration	.009312	1.1640×10^{-3} rev/se

TABLE 3 (Continued)

LUMINARY 178 DAP CONSTANTS

Mnemonic	Description	Program Value	Equivalent
1JACCØN	A constant used to obtain P axis control authority for the docked configuration	Oct. 167	59.50
CØEFF+0	Moment of inertia coefficient for combined CSM LM	0.19518	12.4915 Kg cm^2/rad kg^2
CØEFF+1	Moment of inertia coefficient for combined CSM LM	-0.00529	-1.45410×10^9 Kg cm^2/rad
CØEFF+2	Moment of inertia coefficient for combined CSM LM	-0.17670	-11.3088 Kg cm^2/rad kg^2
CØEFF+3	Moment of inertia coefficient for combined CSM LM	-0.03709	-2.37376 Kg cm^2/rad kg^2
CØEFF+4	Moment of inertia coefficient for combined CSM LM	0.06974	2.92511×10^5 Kg cm^2/rad kg
CØEFF+5	Moment of inertia coefficient for combined CSM LM	0.02569	1.07752×10^5 Kg cm^2/rad kg
CØEFF+6	Coefficient used to find the rate of change of the DPS moment arm around the c.g. of the docked configuration	0.20096	9.3579×10^{-11} cm sec^{-1} rev rad^{-1} kg^{-2}
CØEFF+7	Coefficient used to find the rate of change of the DPS moment arm around the c.g. of the docked configuration	0.13564	0.27128 cm sec^{-1} rev rad
CØEFF+8	Coefficient used to find the rate of change of the DPS moment arm around the c.g. of the docked configuration	0.75704	3.5252×10^{-10} cm sec^{-1} rev rad^{-1} kg^{-2}
CØEFF+9	Coefficient used to find the rate of change of the DPS moment arm around the c.g. of the docked configuration	-0.37142	-1.7296×10^{-10} cm sec^{-1} rev rad^{-1} kg^{-2}
CØEFF+10	Coefficient used to find the rate of change of the DPS moment arm around the c.g. of the docked configuration	-0.63117	-1.9262×10^{-5} cm sec^{-1} rev rad^{-1} kg^{-1}

TABLE 3 (Continued)

LUMINARY 178 DAP CONSTANTS

Mnemonic	Description	Program Value	Equivalent
CØEFF+11	Coefficient used to find the rate of change of the DPS moment arm around the c.g. of the docked configuration	0.41179	1.2567×10^{-5} cm sec^{-1} rev rad^{-1}
ZØNE3MAX	A constant used to define the boundary between ZØNE2 and ZØNE3	0.004375	35 m sec of single firing
FLATVAL	A constant defining the width (attitude error) of ZØNE 2-3	Oct. 443	0.8 deg.
-.03R/S2	A constant defining the minimum acceleration achievable by a single RCS jet	Oct. 77377	1.406 deg/sec^2
.023R/S2	A constant used in conjunction with "-.03R/S2" to define the lower bound on offset acceleration in deadband computation	Oct. 356	1.307 deg/sec^2
RATEDB1	RCS target rate in docked configuration	Oct. 45	0.102°/sec
DGBF	A fractional gain; multiplies the mag. of rate of change of offset acceleration to give the derivative of angular acceleration, in Q and R axes	Oct. 23146	0.3
0.35356	A constant used in the computation of nonorthogonal transformation coefficients in 1/ACCS routine	Oct. 13241	$\sqrt{2}/4$
0.7071	A constant used in the computation of nonorthogonal transformation coefficients in 1/ACCS routine	Oct. 26501	$\sqrt{2}/2$
EPSMAX	Magnitude limit for EPSILØN and -EPSILØN; effectively constrains the U' and V' axes within 15 deg. from the U and V axes	Oct. 62362	0.422668

TABLE 3 (Continued)

LUMINARY 178 DAP CONSTANTS

Mnemonic	Description	Program Value	Equivalent
TØRQCØNS	A double precision constant used in the computation of RCS one-jet acceleration in docked configuration	0.51443×2^{-14}	1078837.9 kg cm^2/sec^2
RATELIM1	Outer rate limit	Oct. 32	1/1.73 deg/sec
RATELIM2	Inner rate limit	Oct. 632	1.126 deg/sec
TORKJET1	Ratio of a single RCS jet torque to DPS gimbals rotation rate	Oct. 01150	157,580 ft-lbs/rad sec
MINLMD	A constant representing the minimum mass of the LM in descent	Oct. 76466	2852 kgs.
MINCSM	A constant representing the minimum mass of the CSM	Oct. 2000	4096 kgs.
MINMINLM	A constant representing the minimum mass of the LM in ascent	Oct. 76731	2200 kgs.
LØASCENT	Lower bound on ascent stage mass	Oct. 01046	2200 kgs.
LØDESCENT	This plus HIASCENT is the lower bound on the unstaged LM mass	Oct. 00666	1752 kgs.
HIDESCNT	Upper bound on descent stage mass	Oct. 10117	16,700 kgs.
NØRMAL	A constant associated with the conversion of a quadratic expression in hand-controller counts to a rate desired in revolutions per sec per RHC-count squared	Oct. 25101	2.0148×10^{-5} rev. per sec per RHC-count squared
FINE	A constant associated with the conversion of a quadratic expression in hand-controller counts to a rate desired in revolutions per sec per RHC-count squared	Oct. 05220	5.0365×10^{-6} rev. per sec per RHC-count squared

TABLE 3 (Continued)

LUMINARY 178 DAP CONSTANTS

Mnemonic	Description	Program Value	Equivalent
1/10	A scale factor applied to RHC for the docked configuration	Oct. 03146	0.1
-.6D/S	One of the values of rate deadband	Oct. 77445	0.6 deg/sec
-.3D/S	One of the values of rate deadband	Oct. 77622	0.3 deg/sec
BIT11	Upper bound on jet-on-time	Oct. 2000	0.25 sec
BIT6	One-jet on-time for minimum impulse	Oct. 00040	7.8 m sec
UTIME	Time between RCS jet firings for docked configuration for U and V axes	Oct. 12	1 sec

TABLE 4

Typographical Errors In Colossus 108 Mnemonics

Incorrect	Correct
7.2DEG	7.25DEG
ISECX	1SECX
DVTHRUST	DVTHRUSH
LBNO	LBN10
EKPRMDT	FKPRIMDT
FCØRFPAC	FCØRFRAC
DXMF1X	DXITFIX
EPRLIM	ERRLIM
1/EPRLIM	1/ERRLIM
NØ.TSVAR	NØ.T5VAR
XLNDX	XLNNDX
XLINDX	XLNINDX
DETMAX	DFTMAX
YJETCØØF	YJETCØDE
DEG409	DEC409
TMAKFIR	TMAXFIRE

TABLE 5

Differences In Listed Colossus 108 Constants

Constant	Listed Value	Program Listing	Remarks
3.1SEC	(3.1 SEC)	OCT 37312	=2.5 to .6 sec
7.25DEG	(7.2509 deg)	DEC 660	=7.25°
100MST5	100 ms	DEC 16374	=100 ms
10SEC	10 sec	DEC 1000	=10 sec
19.77DEG	19.77°	OCT 61740	
SXTVAR	.04 MR^2	0.04 E-6 B+16	
IMUVAR	.04 MR^2	0.04 E-6 B+16	
90MSCALR	90 ms	OCT 440	=90 ms
-DTSCALR	-5.9375 ms	OCT 77754	=-5.9375 ms
PRFUNIT	UNIT	2DEC 0.40957602	=55° deg track axis unit vector
COSTEN	COS(10°)	DEC 0.98481 B-2	=Cosine 10°
MAXRATE	0.1°/sec	2DEC 0.00174	=.1°/sec
DELTYME	1/20 SEC	DEC 0.05 B+2	-1/20 sec
TENTH	0.1	0.1 B+3	=.1 B-3
*VARSUBL	1 NMI^2	DEC 0	
TRUNVAR	.0025 $mrad^2$	2.5 E-9 B+18	
FENG	20,500#	2DEC 9.1188544 B-7	=20,500 lbs
FRCS2	199.6COS10°	2DEC 0.087437837	=199.6 cos 10° lbs
YBIAS	+0.95°	2DEC 0.00263888889	=+0.95°
PBIAS	-2.15°	2DEC 0.00597222222	=-2.15°
S40.135	69.6005 B-23	69.6005183 B-23	
DEG409	5.0	409	=wide DB, 5°
DEC46	0.5	DEC 46	=narrow DB, .5°
* SHAXIS	S321/2,	2DEC 0.5376381241 B-1	

*APPARENT DISCREPANCY

TABLE 5 (Cont'd)

Differences In Listed Colossus 108 Constants

Constant	Listed Value	Program Listing	Remarks
	0	0	
	c 32 1/2	2DEC 0.8431766 920 B-1	
5DEGREES	5°	2 DEC 0.013888889	5 degs
TSIGHT1	240 sec	2DEC 24000	
SIN33	SIN(33°)	2DEC 0.537638121	
COS33	COS(33°)	2DEC 0.8431756920	
CSS66	1/4 COS 76	2DEC 0.060480472	=(COS 76)/4
CSS6640	1/4 (COS 76-COS30)	2DEC 0.15602587	=(COS76-COS30)
CSS33	1/4 COS 38	2DEC 0.197002688	=COS(1/2(76))/
38TRDEG	50°	2DEC 0.66666667	=50°
2.4SECOP	2.4 sec	2DEC 240	
1.9SECOP	1.9 sec	2DEC 190	
C(30)LM	COS 30°	2DEC 0.566985	=1.0-5(COS30)
JTAGTIME	.1 sec	DEC 120	=1.1 sec
KPIP1	$.000585 \times 10^{7}$	2DEC 0.074880	=5.85 cm/sec
-KVSCALE	.81491944	-.81491944	
* LBN10+12	.47115	-.47115	
TCORR	.00005	OCT 00005	
INTVALUE	2685013 - B-20	26850 B-20	
SLOPVAL+9	-1.784 B-6	-1.284 B-6	
1/ACTSAT	.0039525.92	.0039525692	
WL-H/SLP	(NO VALUE GIVEN)	0.00277	=.5°
WLH	.00111111111	.0011111111	=.5°
WL	.00088888888	.0008888888	=.4°/sec
SLOPE2	DEC 32	DEC .32	=.8°/sec

*APPARENT DISCREPANCY

TABLE 5 (Cont'd)

Differences In Listed Colossus 108 Constants

Constant	Listed Value	Program Listing	Remarks
VSQMIN	.61050061	.61050061 E-3	
.166	.1666667	.1666666667	
600MS	600 ms	DEC 60	=600 ms
COARSTOL	DEC-01111	DEC -.01111	
5SEC	50 ms	DEC 500	
4SECS	4 sec	DEC 400	
NEG2	3CDUBITS = 2MIN	OCT 77775	
RTOW	(NO VALUE GIVEN)	DEC .02	
RTODEL	(NO VALUE GIVEN)	DEC .005	
10DEGS-	(NO VALUE GIVEN)	DEC 3600	
20DEGS-	(NO VALUE GIVEN)	DEC -07199	
270DEG	(NO VALUE GIVEN)	OCT 60000	
1/PIPAGT	1/2 sec	OCT 06200	=1/2 sec
1SEC	1 sec	DEC 100	=1 sec
3.5SEC	3 1/2 sec	2DEC 350 B-13	=3.5 sec
1SEC2D	1 sec	2DEC 100.0 B-14	=1.sec
5SECOND	5 sec	2DEC 500.0 B-14	=5 sec
ARATE	.05	.0022222222	=.05°/sec
	.2	.0088888889	=.2°/sec
	.5	.0222222222	=.5°/sec
	28°/sec	.0888888889	=2°/sec
NEGBPW	-15402.B-16	-15402.17 B-16	

TABLE 6

COLOSSUS 108 DAP CONSTANTS

Mnemonic	Description	Program Value	Equivalent
-70 DEGS -15 DEGS	Middle gimbal angle test values for gimbal lock	-.38888 -.08333	-70° -15°
3.1SEC	Delay RCSDAPON for 3.1 sec	ØCT 37312	2.5 + 0.6 sec
7.25DEG	Offset angle between control axes and body axes	660	7.2509°
SINGIMLC	Middle gimbal angle test for attitude pointing to avoid gimbal lock	.4285836003	sin 59°
SINVEC1	Angle used to check "pointing the thrust axis"	.3796356537	sin 49.4°
SINVEC2	Angle used to check "pointing the AOT"	.2462117800	sin 29.5°
VECANG1	Rotation of 50° if VECPOINT is "pointing the AOT"	.138888889	50°
VECANG2	Additional rotation if VECPOINT is "pointing the AOT" to avoid gimbal lock	.097222222	35°
MINANG	Test angle to see if maneuver is less than 0.25°	.00069375	0.252°
MAXANG	Test angle to see if maneuver goes thru gimbal lock	.472222	170.012°
SD K3S1 K4 K45Q SNGLCD CNGL	Transformation matrix about gimbal lock angle (60°), including a buffer angle of 2°	.433015 .86603 -.25 .125 .008725 .499695	sin 60° sin 60° -cos 60° $\cos^2 60°$ sin 2° cos 60° cos 2°
ARATE	Allowable maneuver rates	.0022222222 .0088888889 .0222222222 .0888888889	0.05 °/sec 0.2 °/sec 0.5 °/sec 2.0 °/sec
ANGLTIME	Rescale time from seconds to centi-seconds	100 B-19	100 B-19

TABLE 6 (Continued)

COLOSSUS 108 DAP CONSTANTS

Mnemonic	Description	Program Value	Equivalent
QUADRØT	Rotation matrix for S/C axes to control axes	.1	cos (7.25°)
BIASCALE	Attitude error bias to prevent overshoot	.0002543132	(1/0.6) x 10 x 2^{-16}
MAXRATE	Maximum LOS rate during rendezvous navigation	0.00174	0.1 °/sec
DELTYME	1/Δt used to compute desired desired LOS rate	0.05 B2	1/20 sec
TENTH	Timing for defining incremental changes in IMU angles	0.1 B+3	0.1 sec
MBDYTCL	Matrix for transforming S/C axes to control axes	.5 0 0 0 .99200495 B-1 -.12619897 B-1 0 .12619897 B-1 .99200495 B-1	1 0 0 0 cos 7.5° -sin 7.5° 0 sin 7.5° cos 7.5°
MINDB	Minimum deadband	DEC 46	0.5054°
MAXDB	Maximum deadband	DEC 455	4.9988°
FENG	SPS thrust	9.1188544 B-7	20,500 lbs
FRCS2	RCS ullage	0.087437837 B-7	199.6 cos 10° lbs
18SEC	Delay time for gimbal test	1800	18 secs
3MDØT	3 sec SPS burn mass loss	86.817576 B-16	63.8 lbs/sec
DEC40	Delay for SPS thrust buildup	40	0.4 sec
DEC160	Fixed delay for ullage-off and steering	160	1.6 secs
DEC250	Delay for SPS tailoff	250	2.5 secs
TRIMSCALE	Scale factor operating on PACTOFF and YACTOFF	1.079751 B-1	85.41 x 1/(360 x 36 x 2^{13}

TABLE 6 (Continued)

COLOSSUS 108 DAP CONSTANTS

Mnemonic	Description	Program Value	Equivalent
YBIAS	Yaw mechanical bias	0.00263888889	+0.95°
PBIAS	Pitch mechanical bias	-0.00597222222	-2.15°
2VEXHUST	SPS exhaust velocity factor	63.020792 B-7	10,338 fps
S40.135	Impulse from 7.96 sec of 2 jet firing	69.6005183 B-23	(7.96)(199.6 cos 1 lb-sec
-4ACTDEG	Angle increment in SPS gimbal test	-168	-4°
+2ACTDEG	Angle increment in SPS gimbal test	+84	+2°
DEC409	Deadband test	409	5°
DEC46	Deadband test	46	0.5°
CØNTØNE CØNTTWØ	Constants associated with nominal torque due to one RCS jet	.662034 .00118	
DVTHRUSH	15% of 2 sec PIPA accumulation for full CMS/LM	11	5.8 cm/sec
-MAXDELV	Maximum ΔV test	-6398	3200 pps for 2 sec
JTAGTIME	Delay for activating CM/RCS	120	1.1 sec
SPVQUIT		.019405	1000.2 fps
-KVSCALE	Scale factor for entry velocity	-.81491944	
VCSPS	SPS exhaust velocity	31.510396 B-5	3151.0396 m/sec
VCRCS	RCS exhaust velocity	27.0664 B-5	2706.64 m/sec
MDØTRCS	Mass flow rate for single RCS jet	.0016375 B-3	0.361 lb/sec

TABLE 6 (Continued)

COLOSSUS 108 DAP CONSTANTS

Mnemonic	Description	Program Value	Equivalent
CSMN10	CSM-only filter coefficients	0.99999 -0.2549 0.0588 -0.7620 0.7450 0.99999 -0.4852 0 -0.2692 0	0.99999 -0.5098 0.0588 -1.524 0.7450 0.99999 -0.9704 0.0 -0.5384 0
LBN10	Low bandwidth filter coefficients	0.99999 -.3285 -.3301 -.9101 0.8460 0.03125 0 0 -.9101 0.8460 0.5000 -.47115 0.4749 -.9558 0.9372	0.99999 -.6570 -.3301 -1.8202 0.8460 0.03125 0.0 0.0 -1.8202 0.8460 0.5000 -.9423 0.4749 -1.91162 0.93719
ATTLIM	Initial attitude error limit	.00833	1.494°
1/ATLIM	Attitude error limit	.007325	1.505°
TCØRR	Indicates single shot correction will take place the 6th time that "TVCEXEC" is entered	ØCT 00005	5
FKPRIMDT	Constant used to load KPRIMEDT (guidance error to OMEGAC)	.0102	0.0102
FREPFRAC	Low bandwidth filter gain in REPFRAC	0.0375 B-2	0.0376
FCØRFRAC	Single-shot correction gain for LM-on c.g.	ØCT 10000	0.25

TABLE 6 (Continued)

COLOSSUS 108 DAP CONSTANTS

Mnemonic	Description	Program Value	Equivalent
NØLEMVAL	Coefficients of CSM-alone mass properties polynomial	25445 B-20	18787 slug-ft^2
		87450 B-20	64481 slug-ft^2
		.30715 B-2	0.30713 sec^2
		1.22877 E5 B+12	0.55762 E-5 sec^2/lb
		1.6096 B-6	0.53842 slug-ft^2/lb
		1.54 B-6	0.5149 slug-ft^2/lb
		7.77177 B-6	2.6006 slug-ft^2/lb
		3.46458 E-5 B+12	1.57148 E-5 sec^2/lb
INTVALUE	Coefficients for CSM/LM mass properties polynomials	26850 B-20	19826 slug-ft^2
		127518 B-20	94030 slug-ft^2
		.54059 B-2	0.540527 sec^2
		.153964 E-4 B+12	0.69821 E-5 sec^2/lb
		-.742923 B-6	-.2483 slug-ft^2/lb
		1.5398 B-6	0.5149 slug-ft^2/lb
		9.68 B-6	3.2384 slug-ft^2/lb
		.647625 E-4 B+12	0.293748 E-4 sec^2/lb
		-27228. B-20	-20062 slug-ft^2
		-.206476 B-2	-.206543 sec^2
SLØPEVAL	Coefficients for CSM/LM mass properties polynomials	1.96307 B-6	0.65734 slug-ft^2/lb
		27.5774 B-6	9.2263 slug-ft^2/lb
		2.3548 E-5 B+12	1.06793 E-5 sec^2/lb
		2.1777 E-9 B+26	0.44798 E-9 sec^2/lb/lb
		1.044 E-3 B+8	0.158433 E-3 slug-ft^2/lb/
		0	0
		2.21068 E-3 B+8	0.33546 E-3 slug-ft^2/lb/l
		1.5166 E-9 B+26	0.31212 E-9 sec^2/lb/lb
		-1.284 B-6	-0.43 slug-ft^2/lb
		2. E-5 B+12	0.90706 E-5 sec^2/lb

TABLE 6 (Continued)

COLOSSUS 108 DAP CONSTANTS

Mnemonic	Description	Program Value	Equivalent
NEGBPW	Complement of CSM"Breakpoint" weight for computation of mass properties	-15402.17 B-16	-33960 lbs
DXITFIX	Mass property constant for LM-on APS only configuration	-1.88275 E-5 B+12	-0.85367 E-5 sec^2/lb
ACTSAT	Actuator limit	DEC 253	6.0024°
1/ACTSAT	Reciprocal of actuator limit	0.003967285	
ERRLIM	Filter input limit	BIT 13	45°
1/ERRLIM	Reciprocal of ERRLIM	BIT 3	
1/RTLIM	Test for excessive CDU rates (>2.33°) for pitch and yaw passes	.004715	2.34°
1-E(-AT)	Used in establishing TVC DAP filters	ØCT 00243	0.01
E(-AT)	Used in establishing TVC DAP filters	ØCT 37535	1-0.01
DB	Roll deadband for TVC DAP	.01388889	5.0098°
-SLØPE	TVC roll DAP phase-plane slope value	0.2	0.2
LMCRATE	Limit cycle roll rate for TVC roll DAP	.00027778 B+4	0.10025 °/sec
INTERCEP	TVC roll DAP phase-plane intercept	.0025 B+3	0.9009°
MINLIM	TVC roll DAP phase-plane minimum rate limit	.00277778 B+4	1°/sec
1/MINLIM	Reciprocal of MINLIM	360 B-18	
MAXLIM	TVC roll DAP phase-plane maximum rate limit	.01388889 B+4	5 °/sec

TABLE 6 (Continued)

COLOSSUS 108 DAP CONSTANTS

Mnemonic	Description	Program Value	Equivalent
TMINFIRE	Minimum RCS jet firing time	1.5 B+4	15 ms
TMAXFIRE	Maximum RCS jet firing time	250 B+4	2.5 secs
1/TMXFIR	Timing to allow 2.56 sec firing before applying limit	BIT 3	
DELTATT	Timing for initialization of attitude rates using Kalman filter	ØCT 37770	80 ms
DELTATT2	Additional time delay to assure TSRUPT during initialization of attitude rates	ØCT 37776	20 ms
DELAY200	Tilt logic, reinitialize DAP in 200 ms	16364	200 ms
DACLIMIT	Overflow limit on DAC	16000	384 pulses
NØ.T5VAR	Used in determining the number of locations to be zeroed in establishing DAP configuration	35	
=.24	Slope of 0.6/sec for initializing switching logic	.24	0.6 /sec
RCSINIT	Assume we have a good IMU and allow initialization	ØCT 00004	
MANTABLE	Rate value for loading into WBØDY or MERRØR	.0071111 -.0071111 .028444 -.028444 .071111 -.071111 .284444 -.284444	0.05 °/sec -0.05 °/sec 0.20 °/sec -0.20 °/sec 0.50 °/sec -0.50 °/sec 2.00 °/sec -2.00 °/sec
=+14MS	Enable T6RUPT to shut off jets in 14 ms	23	14 ms

TABLE 6 (Continued)

COLOSSUS 180 DAP CONSTANTS

Mnemonic	Description	Program Value	Equivalent
GAIN1+0	Kalman filter gains for initialization of attitude rates	.0640	.06043 ss gain
+1		.3180	.31799
+2		.3452	.34521
+3		.3774	.37738
+4		.4161	.41608
+5		.4634	.46338
+6		.5223	.52228
+7		.5970	.59698
+8		.6933	.69330
+9		.8151	.81512
+10		.9342	.93420
-3	Gain for translation, LM-on	.2112	0.21118
-2	Gain for translation, LM-off	.8400	0.84003
-1	High rate automatic/RHC maneuvers	.2112	0.21118
GAIN2+0	Kalman filter gains for initialization of attitude rates	.0016	.00159 ss gain
+1		.0454	.04541
+2		.0545	.05450
+3		.0666	.06659
+4		.0832	.08319
+5		.1069	.10687
+6		.1422	.14221
+7		.1985	.19849
+8		.2955	.29547
+9		.4817	.48169
+10		.8683	.86829
-3	Gain for translation, LM-on	.0174	.01740
-2	Gain for translation, LM-off	.3600	.35999
-1	High rate automatic/RHC maneuvers	.0174	.01740
MINTAU	Minimum time values	0 23 -23 0	0 14 ms -14 ms 0
WLH/SLØP	RCS DAP phase-plane variable	.00463	0.835°
WL-H/SLØP	RCS DAP phase-plane variable	.00277	0.5°

TABLE 6 (Continued)

COLOSSUS 108 DAP CONSTANTS

Mnemonic	Description	Program Value	Equivalent
WLH	RCS DAP phase-plane rate limit	.0011111111	0.5 °/sec
WLMH	RCS DAP phase-plane rate limit	.0006666666	0.3 °/sec
WL	RCS DAP phase-plane rate limit	.0008888888	0.4 °/sec
SLØPE2	RCS DAP phase-plane hysteresis slope	.32	0.8 °/sec/sec
QVADANG	Offset angle of roll jets	660	7.25°
DELATT3	Jet logic timing to call for a reset to execute Phase 1 logic	16378	60 ms
DELATT20	Jet logic timing to insure a T5RUPT	16382	20 ms
XLNNDX+0	Indices used for combining translation and rotation commands	0	
+1		3	
+2		6	
+3		0	

Mnemonic	Description	Program Value	RØT	TRANS	QUAD B
PYTABLE	Table giving information on pitch and yaw jets selected, together with number of jets used for the function	ØCT 0	0	0	
		ØCT 5125	+	0	
		ØCT 5252	-	0	
		ØCT 0231	0	+	
		ØCT 2421	+	+	
		ØCT 2610	-	+	
		ØCT 0146	0	-	
		ØCT 2504	+	-	
		ØCT 2442	-	-	
		ØCT 0	0		A(B)
		ØCT 2421	+		A(B)
		ØCT 2442	-		A(B)
		ØCT 0	0		C(D)
		ØCT 2504	+		C(D)
		ØCT 2610	-		C(D)

Mnemonic	Description	Program Value	Equivalent
XLNINDX+0	Indices for translation based on configuration	0	
+1		1	
+2		2	
+3		0	

TABLE 6 (Continued)

COLOSSUS 108 DAP CONSTANTS

Mnemonic	Description	Program Value	Equivalent			
		ØCT	RØLL	TRANS	QDFAIL	BI
RTABLE	Table giving information on roll jets selected, together with number of roll jets	11000	0			
		22125	+			
		00252	-			
		11231	0	+Y/+Z		
		15421	+	+Y/+Z		
		04610	-	+Y/+Z		
		11146	0	-Y/-Z		
		15504	+	-Y/-Z		
		04442	-	-Y/-Z		
		11000	0		A(B)	
		15504	+		A(B)	
		04610	-		A(B)	
		11000	0		C(D)	1
		15421	+		C(D)	1
		04442	-		C(D)	1

Mnemonic	Description	Program Value	Equivalent		
		ØCT	TRANS	QDFAIL	BIAS
YZTABLE	Table giving information permitting the combination of Y or Z translations with roll, as well as number of jets giving a "net roll torque"	11000	0		0
		11231	+Z/+Y		0
		11146	-Z/-Y		0
		11000	0	B(A)	3
		04610	+Z/+Y	B(A)	3
		15504	-Z/-Y	B(A)	3
		11000	0	D(C)	6
		15421	+Z/+Y	D(C)	6
		04442	-Z/-Y	D(C)	6

Mnemonic	Description	Program Value	Equivalent
=-.1SEC	Check on rotation on-time	-160	-.1 sec
=+.1SEC	Check on rotation on-time	160	+.1 sec
DFTMAX-3	Check on rotation on-time	-480	-.3 sec
-2		-320	-.2 sec
-1		-160	-.1 sec
+0		0	0
+1		160	+.1 sec
+2		320	+.2 sec
+3		480	+.3 sec
=14MS	Test to see if jet on-time computation is less than minimum impulse time	23	14.4 ms

TABLE 6 (Continued)

COLOSSUS 108 DAP CONSTANTS

Mnemonic	Description	Program Value	Equivalent
NJET-3	Used to correct jet burn times	-.333333	-1/3
-2	for the number of jets actually	-.500000	-1/2
-1	used	-.999999	-1 (negmax)
0		0	
1		.999999	+1 (posmax)
2		.500000	+1/2
3		.333333	+1/3
NSEC	Deadzone logic for entry DAP. Time to travel 65° at 3°/sec	2100	65/3 sec
4D/SLIM	Entry DAP limit check	16348	4.065 °/sec
YDØTLIM	Entry DAP limit check	16366	2.087 °/sec
CM/BIAS	Entry DAP error bias	55	0.604°
YAWLIM	Entry DAP limit check	16055	3.625°
C45LIM	Entry DAP limit check	.29289	cos 45°
SINTRIM	Entry DAP sine of trim angle for L/D = 0.3	-.34202	sin (-20°)
CØSTRIM	Entry DAP cosine of trim angle for L/D = 0.3	.93969	cos (-20°)
YJETCØDE-1	Entry DAP jet select	ØCT 120	+Y
+0		ØCT 0	None
+1		ØCT 240	-Y
P/RJCØDE-1	Entry DAP jet select	ØCT 00005	+R/+P
+0		ØCT 00000	0
+1		ØCT 00012	-R/-P
VSQMIN	Entry DAP limit test	.61050061 E-3	.61035 E-3
2T/TCDU	Entry DAP cycle structure	ØCT 50	40 x 2^{-14} revs/DAP cyc
180/8ATT	Entry DAP constant for relating maneuver to acceleration	.61813187	9.1
2JETT	Timing structure for entry DAP for performance of roll command updates	4	2 sec

TABLE 6 (Continued)

COLOSSUS 180 DAP CONSTANTS

Mnemonic	Description	Program Value	Equivalent
4JETT	Timing structure for entry DAP for performance of roll command updates	800	4 sec
XMIN/360	Entry DAP limit test	182	182×2^{-14}
-VM/360K	Entry DAP limit test associated with maximum roll rate limit	-.22222222	
XS/360K	Entry DAP limit test	91	91×2^{-14}
KTRCS	Entry DAP constant associated with rate at which error is reduced	0.5	0.5
5SEC	Time delay in SPS gimbal trim task	500	5 secs
RTØW	PTC rate	.02	.02 °/sec
RTØDEL	PTC rate	.005	.005 °/sec
3.5SEC	P40-47 burn time computations	350 B-13	3.5 secs
DEC6	Procedural delay for relay latching	6	60 ms
DEC2	Procedural delay for relay latching	2	20 ms
DEC200	Delay for astronaut verification of gimbal motion	200	2 secs
DEC400	Wait 4 secs before gimbal trim	400	4 secs