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DANCE Memo #51, COLOSSUS Memo #42, LUMINARY Memo #17

TO: Distribution
FROM: J. A. Saponaro
DATE: 5 April 1968
SUBJECT: AGC Time Dependent Constants

A consistent set of fixed memory constants and pad loaded erasables pertaining to ephemeris and other time dependent data are required in SUNDANCE, LUMINARY and COLOSSUS for all levels of testing. This memo identifies these data as well as the values used for years 67/68 and 68/69.

Fixed constants for year 68/69 appear in all revisions of COLOSSUS since Revision 142 and in SUNDANCE since Revision 258. Thus, if it is desired to duplicate a 67/68 test run before these revisions, on a current revision it is necessary to change these fixed constants, and retain the 67/68 erasable loads.

Assembly control will maintain a card supply of the erasable constants for year 68/69 and erasables plus fixed constants for year 67/68.

SUNDANCE Level 1, 2 and 3 testing was done using 67/68 fixed constants and erasables. Level 4 and 5 testing is being done using 68/69 data.

COLOSSUS and LUMINARY Level 1 and 2 testing is being done partially with 67/68 data and partially with 68/69 data. However, Level 3, 4, 5 testing will be done using 68/69 data.

Items 1, 4, 13, thru 26 are dependent on launch date while all others are constant over the year (67/68, 68/69). The launch date dependent data for both years was arbitrarily selected and agreed upon for testing purposes. The 1968/69 launch date is March 16, 1969 1500 hrs GMT.

It is further recommended that testing be done using 1968/69 data to eliminate some of the confusion that may occur with the test case decks being propagated thru level 2, 3, 4 and 5 testing and henceforth.

DEFINITION

<u>GSOP Symbol</u>	<u>Program Tag</u>	<u>Values 67-68</u>	<u>Values 68-69</u>	<u>Units</u>	<u>Rope</u>	<u>F/E</u>
1. t_o is the elapsed time between July 1.0 00 hrs., and the time the AGC computer clock was zeroed.						
t_o	TEPHEM	6*	8*		Colossus Luminary Dance	E Pad Loaded
	TEPHEM +1	252599384	87036352			

NOTES: 1) This time is carried in triple precision CS in the AGC.

2) 1967-68 Value is 215.649551 days universal time, i.e., Feb 1 XX hrs. 1968 or 1.86321212E7 secs.

3) 1968-69 Value is 258.625 days universal time, i.e., March 16, 15 hrs. 1969 or 2.23452E7 secs.

2. These are small angles about the X & Y reference axes that describe precession and nutation of the earth's polar axis.

A_{xo}	AXO	4.107393985 E-5	4.652459653 E-5	Radians	Colossus Luminary Dance	E Pad Loaded
A_{yo}	-AYO	3.8135575 E-7	2.147535898 E-5	Radians		

NOTES: 1) The AGC program carries minus AYO.

2) -AYO & AXO are equated to UNITW and UNITW +2 in the AGC.

3. Angle between the X-axis of the basic reference coordinate system and the X-axis of the earth-fixed coordinate system (i.e., the angle formed by the intersection of the Greenwich meridian and the equatorial plane of the earth.

A_{zo}	AZO	.773245903	.7753206164	Revs.	Colossus Luminary Dance	E Pad Loaded
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NOTES: 1) 1967-68 value equivalent to 4.8584473 rads.; 1968-69 value equivalent to 4.87148308.

* Single precision.

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4. Moon libration vector, to correct for deviations because of physical libration of the moon. Required for all lunar sphere cases, orbital ca.						
$\vec{L}_M$	504LM	2.846050548 E-4	-2.700340601 E-5	Radians	Colossus Luminary Dance	E Pad Loaded
	504LM+2	-3.247711332 E-4	-7.514128401 E-4	Radians		
	504LM+4	2.574687483 E-4	2.553198642 E-4	Radians		
5. Landing site position vector in moon fixed coordinates.						
$\vec{r}_{LS}$	RLS				Colossus Luminary Dance	E
NOTES: 1) This is required for all lunar cases definitely for cases where LM is on lunar surface. 2) This value may be specified for the particular landing site. However, if it is not of primary concern initialize it to $(R_M, 0, 0)$ = $\vec{R}_{LS}$ where R_M is equatorial radius of the moon, 1738090 meters. (B-27)						
6. Derivative of the longitude of the node of the moon's orbit measured from the X-axis of the basic reference coordinate system.						
$\dot{\Omega}_I$	NODOT	-1.07047018 E-8 Programmed Value -.457335152 E-2	1.07047016 E-8 -.457335143 E-2	Rad/sec Revs/cs	Colossus Luminary Dance	F
7. Derivative of the angle from the mean ascending node of the moon's orbit to the mean moon.						
$\dot{F}$	FDOT	2.67240417 E-6 Programmed Value .570863341	2.67240019 E-6 .570862491	rad/sec revs/cs	Colossus Luminary Dance	F
8. Derivative of obliquity angle, i.e., angle between the mean earth equatorial plane and the plane of the ecliptic.						
$\dot{B}$	BDOT	7.19755996 E-14 Programmed Value -3.075 E-8	-7.19756666 E-14 -3.07500412 E-8	rad/sec revs/cs	Colossus Luminary Dance	F

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9.	Longitude of the node of the moon's orbit measured from the X-axis of the basic reference coordinate system at July 1 universal time.					
Ω_{I0}	NODIO	-5.69422959 Programmed Value -.906264786	-6.03249419 -.960101269	Radians revs.	Colossus Luminary Dance	F
10.	Angle from the mean ascending node of the moon's orbit to the mean moon at July 1 universal time.					
F_o	FSUBO	6.07078060 Programmed value .966194741	2.61379488 .415998375	Radians revs.	Colossus Luminary Dance	F
11.	The obliquity angle between the mean earth equatorial plane and the plane of the ecliptic at July 1, universal time.					
B_o	BSUBO	.4901664488 Programmed value .0651208628	.490164173 .0651205006	Radians rev.	Colossus Luminary Dance	F
12.	Angular velocity of the earth.					
W_E	Wearth	7.29211504 E-5 Programmed value .973561841	7.29211515 E-5 .973561855	rad/sec. revs/cs	Colossus Luminary Dance	F
13.	Position vector of the sun relative to the earth at time t_{MO}					
$\underline{r}_{ESO}$	RESO	1.114662698 E11	1.489564329 E11 B-38 Meters		Colossus *	E Pad Loaded
	RESO +2	-8.873060902 E10	7.001301317 E9 B-38 Meters			
	RESO +4	-3.847685663 E10	3.036173851 E9 B-38 Meters			
14.	Velocity vector of the sun relative to the earth at time t_{MO}					
$\underline{v}_{ESO}$	VESO	1.999857729 E2	-1.047351259 E1 B-9 meters/cs		Colossus	E Pad Loaded
	VESO +2	2.074316128 E2	2.739637049 E2 B-9 meters/cs			
	VESO +4	8.9956848755 E1	1.188053556 E2 B-9 meters/cs			

* This constant and all thru number 26 are not defined in DANCE and LUMINARY.

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15. The elapsed time between July 1 universal time and the time at the center of the range over which the lunar-position polynomial is valid.						
t_{MO}	TIMEMO	7^*	8^*		Colossus	E Pad Loaded
	TIMEMO +1	45508205	148592749			
NOTES: 1) 67-68 Values corresponds to 222.7495803 U. T. days or 1.924556397 E7 secs. 2) 68-69 Value corresponds to 265.749583 (U. T.)days or 2.296076397 E7 secs.						
16. Angular velocity of the vector $\underline{r}_{ESO}$ at time t_{MO} .						
ES	OMEGAES	3.255230500 E-10 2.045321678 E-7	3.187964972 E-10 B-26 rev/cs rad/sec		Colossus	E Pad Loaded
17. Vector co-efficients used in determining the approximate position and velocity of the moon, $\underline{r}_{EM}$ and $\underline{V}_{EM}$ respectively.						
$\underline{C}_9$	VECOEM	2.934810447 E-3 B-2	2.230245527 E-03 B-2		Colossus	E Pad Loaded
	VECOEM +2	-2.243511923 E-4 B-2	-1.301642810 E-03 B-2			
	VECOEM +4	-2.281630795 E-4 B-2	-7.152334072 E-04 B-2			
18. Vector coefficients, etc.						
$\underline{C}_8$	VECOEM +6	1.407069657 E-3 B-2	-4.980632171 E-03 B-2			
	VECOEM +8	-6.084651689 E-3 B-2	-3.722876152 E-03 B-2			
	VECOEM +10	-3.323909247 E-3 B-2	-2.035268961 E-03 B-2			
19. Vector coefficients, etc.						
$\underline{C}_7$	VECOEM +12	-1.686062819 E-2 B-2	-9.334459545 E-03 B-2		Colossus	E Pad Loaded
	VECOEM +14	-5.250661370 E-3 B-2	1.197694448 E-02 B-2			
	VECOEM +16	-2.221366878 E-3 B-2	6.570322504 E-03 B-2			

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20. Vector coefficients, etc.						
<u>C</u> ₆	VECOEM +18	-1.962422059 E-2 B-2	2.319080030 E-02 B-2		Colossus	E Pad Loaded
	VECOEM +20	-1.472869452 E-2 B-2	1.703964281 E-03 B-2			
	VECOEM +22	8.589966689 E-3 B-2	9.021412181 E-04 B-2			
21. Vector coefficients, etc.						
<u>C</u> ₅	VECOEM +24	-2.255413560 E-2 B-2	-4.471818365 E-02 B-2		Colossus	E Pad Loaded
	VECOEM +26	4.219583476 E-2 B-2	-1.687552547 E-02 B-2			
	VECOEM +28	2.365598977 E-2 B-2	-9.225831175 E-03 B-2			
22. Vector coefficients, etc.						
<u>C</u> ₄	VECOEM +30	1.081271794 E-1 B-2	3.459615003 E-02 B-2		Colossus	E Pad Loaded
	VECOEM +32	1.624584675 E-1 B-2	1.792014329 E-01 B-2			
	VECOEM +34	8.356867726 E-2 B-2	9.827170405 E-02 B-2			
23. Vector coefficients, etc.						
<u>C</u> ₃	VECOEM +36	5.353095419 E-1 B-2	5.344203821 E-01 B-2		Colossus	E Pad Loaded
	VECOEM +38	-1.650550276 E-1 B-2	-1.603764772 E-01 B-2			
	VECOEM +40	-1.085165633 E-1	-8.811510864 E-02 B-2			
24. Vector coefficients, etc.						
<u>C</u> ₂	VECOEM +42	-3.089774542 E-1 B-2	-3.862234545 E-01 B-2		Colossus	E Pad Loaded
	VECOEM +44	-8.952820888 E-1 B-2	-8.580240001 E-01 B-2			
	VECOEM +46	-4.696171346 E-1 B-2	-4.700758013 E-01 B-2			

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25. Vector coefficients, etc.						
$\underline{C}_1$	VECOEM +48	-1.181030463 B-2	-1.115870224 E-00 B-2		Colossus	E Pad Loaded
	VECOEM +50	2.540204902 E-1 B-2	4.285124106 E-01 B-2			
	VECOEM +52	1.786115499 E-1 B-2	2.353171565 E-01 B-2			
26. Vector coefficients, etc.						
$\underline{C}_0$	VECOEM +54	2.128967129 E-1 B-2	2.798912865 E-01 B-2		Colossus	E Pad Loaded
	VECOEM +56	6.337656908 E-1 B-2	6.086647574 E-01 B-2			
	VECOEM +58	3.321113794 E-1 B-2	3.334296791 E-01 B-2			