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CONORB

by

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PURPOSE

The purpose of CONORB is to produce an RBIT tape in PDP-11 format from MCE tapes written in IBM 7Ø94 format.

The format of the MCE tapes is described in the IMP-H MCE tape write-up. Only data records are processed - the title records are ignored. The MCE tape is seven track, hence each 36-bit 7Ø94 number will occupy 3 words of PDP-11 storage. The 7Ø94 numbers are re-formatted into PDP-11 floating point. Some of these numbers are changed to integers, and some additional data is computed (e.g., computing θ & ϕ from X, Y, Z coordinates). The data is then written on the RBIT tape in PDP-11 format for access by other programs.

Notice that under-flow and over-flow in the 7Ø94 to PDP-11 conversion is not a problem because PDP-11 floating point is more precise than IBM 7Ø94 floating point.

COMMANDS

CONORB first prints the version number and date of assembly. It then requests:

```
RBIT TAPE #nnnnnn
  UNIT : FILE : RECORD = u:fff:rrr

MCE TAPE #nnnnnn
  UNIT : FILE : RECORD = u:fff:rrr

NUMBER OF MCE TAPES = m

DO YOU WANT A TAPE DUMP ? a
```

WHERE nnnnnn = any six ASCII characters
u = unit number
fff = file number
rrr = record number
m = number of MCE tapes to be combined onto the RBIT tape
a is a character string. If the first character is a Y then a dump is produced. Otherwise, no dump is produced.

All numbers are in octal. The number fields u:fff:rrr are interpreted as in SRLSYS, that is:

> Each field begins with the first character with ASCII value > 57 and ends with the first character greater than 67 or less than 6Ø. Omitted fields default to zero.

Files and records are numbered from one. If an illegal or non-existing file or record are specified, the program will request a new number.

Example:

```
RBIT TAPE   # RBITØ1
  UNIT : FILE : RECORD = 1:1:Ø
  UNIT : FILE : RECORD = 1:1
  UNIT : FILE : RECORD = 1:1:1
MCE TAPE  #
                    etc.
```

Instead of specifying an RBIT record number, the ASCII character L may be typed instead. This causes the RBIT tape to be positioned at the end of the file so that additional records may be added.

If more than one MCE tape is specified, the program will convert the first tape and then request additional MCE tapes. These will be added onto the same file.

Note: The time difference between records must be greater than four minutes. The program will skip MCE records until it finds a record more than four minutes ahead of the last record written. The only time this check is not made is when an RBIT record is specified by number. In this case the first record is transfered regardless of the time span.

OUTPUT

If the first MCE record on the tape is read, its fractional day number will be printed on the teletype. The FDN of the last record on the tape will also be printed.

If a dump is requested, the numbers on the tape are converted to ASCII decimal numbers and then printed.

ERRORS

The SRLSYS GET/PUT routine is used for Mag tape read and write. If an error occurs on input, no output will occur. An output error will write the record with extended inter-record gap.

In case of error a message will be printed indicating the error and where it occurred.

Example:

```
MTS=ØØØ1ØØ11Ø1Ø1Ø1ØØ


INPUT ERROR
MCE FILE : RECORD = ØØØØØ1 :ØØØØØ5
RBIT RECORD = ØØØ335
```

Only $2734Ø_8$ (12000) records may be written on an RBIT file (normally an RBIT tape will only have one file). When this limit is reached, a message is printed indicating this fact and the program will restart.

Example:

```
2734Ø RECORDS ON RBIT TAPE
LAST MCE FILE : RECORD = XXXXXX : YYYYYY
```

RBIT TAPE

FORMAT

Word	Value	Units	Type	Word on MCE
0-2	RBIT tape number	6 char	ASCII	
3	RBIT record number		Integer	
4-6	MCE tape number	6 char	ASCII	
7	MCE file number		Integer	
8	MCE record number		Integer	
9	Program version number		Integer	
10-12	Fractional day number		Real	
13	Day of year	Day	Integer	1
14-15	Milliseconds of day	Milliseconds	Double-Integer	2
16	Year	Last 2 digits	Integer	72
17	Ascending node crossing number		Integer	71
18	(zero fill)			
19-21	Longitude } geocentric	Degrees	Real	3
22-24	Latitude } geocentric	Degrees		4
25-27	Longitude } geomagnetic	Degrees		5
28-30	Latitude } geomagnetic	Degrees		6
31-33	R (geomagnetic coor.)	Earth-radii		7
34-36	r (radial distance)	KM		8
37-39	GSE-X } satellite	KM		9
40-42	GSE-Y } satellite	KM		10
43-45	GSE-Z } satellite	KM		11
46-48	GSM-X } satellite	KM		12
49-51	GSM-Y } satellite	KM		13
52-54	GSM-Z } satellite	KM		14
55-57	GSE-X } Moon	KM		15
58-60	GSE-Y } Moon	KM		16
61-63	GSE-Z } Moon	KM		17
64-66	GSM-X } Moon	KM		18
67-69	GSM-Y } Moon	KM		19
70-72	GSM-Z } Moon	KM	Real	20

Word	Value	Units	Type	Word on MCE
73-75	GEI-X } satellite	KM	Real	21
76-78	GEI-Y } satellite	KM		22
79-81	GEI-Z } satellite	KM		23
82-84	GEI-X } Sun	AU		24
85-87	GEI-Y } Sun	AU		25
88-90	GEI-Z } Sun	AU		26
91-93	Longitude } sub-solar point in GM	Degrees		27
94-96	Latitude } sub-solar point in GM	Degrees		28
97-99	Satellite-Moon distance	KM		29
100-102	Satellite-Moon distance parallel to GEI-X axis	KM		30
103-105	(1,1) } GSE to GSM transform matrix			31
106-108	(1,2) } GSE to GSM transform matrix			32
109-111	(1,3) } GSE to GSM transform matrix			33
112-114	(2,1) } GSE to GSM transform matrix			34
115-117	(2,2) } GSE to GSM transform matrix			35
118-120	(2,3) } GSE to GSM transform matrix			36
121-123	(3,1) } GSE to GSM transform matrix			37
124-126	(3,2) } GSE to GSM transform matrix			38
127-129	(3,3) } GSE to GSM transform matrix			
130-132	(1,1) } GEI to GSE transform matrix			40
133-135	(1,2) } GEI to GSE transform matrix			41
136-138	(1,3) } GEI to GSE transform matrix			42
139-141	(2,1) } GEI to GSE transform matrix			43
142-144	(2,2) } GEI to GSE transform matrix			44
145-147	(2,3) } GEI to GSE transform matrix			45
148-150	(3,1) } GEI to GSE transform matrix			46
151-153	(3,2) } GEI to GSE transform matrix			47
154-156	(3,3) } GEI to GSE transform matrix			48
157-159	Rt. ascension } satellite in celes. inertial	Degrees		49
160-162	Declination } satellite in celes. inertial	Degrees		50
163-165	Rt. ascen. } velocity vector in celestial inertial			51
166-168	Declination } velocity vector in celestial inertial	Degrees		52
169-171	Magnitude of velocity	KM/sec	Real	53

Word	Value	Units	Type	Word on MCE
172-174	(zero fill)			
175-177				
178-180				
181-183	Satellite-Earth-Sun angle	Degrees	Real	57
184-186	Satellite-Earth-Moon angle	Degr-es		58
187-189	Theta, satellite in GSE	Degrees		
190-192	Phi, satellite in GSE	Degrees		
193-195	Longitude, Sub-solar point in GEI	Degrees		61
196-198	Latitude, Sub-solar point in GEI	Degrees		62
199-201	Theta, satellite in GSM	Degrees		
202-204	Phi, satellite in GSM	Degrees		
205-207	Theta, satellite in GEI	Degrees		
208-210	Phi, satellite in GEI	Degrees		
211-213	Date (yr-mo-da)	yr-mo-da		67
214-216	Longitude, geodetic satellite position	Degrees		68
217-219	Latitude, geodetic satellite position	Degrees		69
220-222	Height above spheroid	KM		70
223-225	(zero fill)			
226-228				
229-231				
232-234				
235-237				
238-240	Delta time	Seconds		76
241-243	Spin period	Seconds		77
244-246	Rt. Ascenson, spin vector in celestial inertial	Degrees		78
247-249	Declination, spin vector in celestial inertial	Degrees	Real	79
250-252	(zero fill)			
253-255				
256-258				
259-261				
262-264				
265-267				
268-270				
271-273				
274-276				
277-279				

EXAMPLES

Multiple MCE tapes

```
CONORB VERSION  000000,9-JAN-73

RBIT TAPE #HSKR18
  UNIT : FILE : RECORD  = 2:1:1

MCE TAPE #H00001
  UNIT : FILE : RECORD  = 3:1:1

NUMBER OF MCE TAPES = 3

DO YOU WANT A TAPE DUMP ? NO

FIRST FDN =  .27351389E  3

MTS=0100000001010100

MTS=0100000001010100

LAST FDN  =  .27384028E  3

MCE TAPE #H00002
  UNIT : FILE : RECORD  = 3:1:1

FIRST FDN =  .28467361E  3

MTS=0100000001010100

MTS=0100000001010100

LAST FDN  =  .28584028E  3

MCE TAPE #H00003
  UNIT : FILE : RECORD  = 3:1:1
```

Using the L switch

```
CONORB VERSION  000000,9-JAN-73

RBIT TAPE #HSKR18
  UNIT : FILE : RECORD  = 2:1:L

MTS=0100000001010000

MCE TAPE #H00002
  UNIT : FILE : RECORD  = 3:1:1

NUMBER OF MCE TAPES = 1

DO YOU WANT A TAPE DUMP ? NO

FIRST FDN =  .28467361E  3

MTS=0100000001010100

MTS=0100000001010100

LAST FDN  =  .28584028E  3

MTS=0100000001010000
```

Tape Dump

```
CONORB VERSION  000000,9-JAN-73

RBIT TAPE #HSKR18
  UNIT : FILE : RECORD  = 2:1:1

MCE TAPE #H0Q002
  UNIT : FILE : RECORD  = 3:1:1

NUMBER OF MCE TAPES = 1

DO YOU WANT A TAPE DUMP ? YES

FIRST FDN =   .28467361E  3

 .28467361E  3     284     582000000      72        2        0
-.14855947E  2 -.15113164E  1  .52044075E  2  .48002120E  1
 .35637517E  2  .22571072E  6  .14913647E  6  .15330414E  6
 .72121312E  5  .14913647E  6  .16931218E  6  .60850820E  4
 .32401887E  6  .24250428E  6 -.29117617E  4  .32401887E  6
 .21126960E  6 -.83329356E  4 -.34739581E  5 -.58258395E  5
-.65831739E  4 -.47623336E -1 -.22549810E  0 -.59677567E -2
 .32132371E  1  .49333517E  1  .22122374E  6  .17488241E  6
 .10000000E  1  .00000000E  0  .00000000E  0  .00000000E  0
 .91957396E  0  .39291696E  0  .00000000E  0 -.10708304E  0
 .91957396E  0 -.45972027E -1 -.22502222E  0 -.57614036E -2
 .29971757E  0 -.12472101E  0 -.12045283E  0  .00000000E  0
-.10216347E  0  .91745632E  0  .24471007E  3 -.15113164E  1
 .33574319E  3  .16808623E  2  .13318086E  1  .00000000E  0
 .00000000E  0  .00000000E  0  .48643538E  2  .24505142E  2
 .00000000E  0  .00000000E  0 -.62224350E  2 -.11518363E  1
 .00000000E  0  .00000000E  0  .00000000E  0  .00000000E  0
 .72101000E  6 -.14855947E  2 -.15108430E  1  .21933260E  6
 .00000000E  0  .00000000E  0  .00000000E  0  .00000000E  0
 .00000000E  0  .51190000E  4  .12975000E  4  .90000000E  2
-.52800000E  2  .00000000E  0  .00000000E  0  .00000000E  0
 .00000000E  0  .00000000E  0  .00000000E  0  .00000000E  0
 .00000000E  0  .00000000E  0  .00000000E  0
```

ATTITUDE/ORBIT/EPHEMERIS TAPE FORMAT

All words are 36 bits long, IBM 7094 format.

The time interval between records shall be 10 minutes.

WORD NO.	FORM	IDENTIFICATION
0	Fixed Pt.	Fortran record size indicator (=000117010001) This indicates a total data word count of 75 .
1	Floating Pt.	Day of year } time of orbit data
2	" "	Milliseconds of day } in this record
3	" "	Longitude (deg.) } satellite position in
4	" "	Latitude (deg.) } geocentric coordinates
5	" "	Longitude (deg.) } satellite position in
6	" "	Latitude (deg.) } geomagnetic coordinates
7	" "	R (earth radii) a geomagnetic coordinate of the satellite position, C.U.L.
8	" "	r, radial distance of the satellite from the center of the earth (km.)
9	" "	GSE X } Satellite position in Geocentric Solar
10	" "	GSE Y } Ecliptic Coordinates (km.)
11	" "	GSE Z }
12	" "	GSM X } Satellite position in Geocentric Solar
13	" "	GSM Y } Magnetospheric Coordinates (km.)
14	" "	GSM Z }
15	" "	GSE X } Moon position in Geocentric Solar
16	" "	GSE Y } Ecliptic Coordinates (km.)
17	" "	GSE Z }
18	" "	GSM X } Moon position in Geocentric Solar
19	" "	GSM Y } Magnetospheric Coordinates (km.)
20	" "	GSM Z }

WORD NO.	FORM	IDENTIFICATION
21	Floating Pt.	GEI X — Satellite position in Geocentric Equatorial Inertial (km.)
22	" "	GEI Y
23	" "	GEI Z
24	" "	GEI X — Sun position in Geocentric Equatorial Inertial (A.U.)
25	" "	GEI Y
26	" "	GEI Z
27	" "	Longitude — Sub-solar point in geomagnetic coordinates (deg.)
28	" "	Latitude
29	" "	Distance from the satellite to the Moon (km.)
30	" "	Distance parallel to the x-axis from the satellite to the moon (km.)
31	" "	1st row, 1st column — Geocentric Solar Ecliptic to Geocentric Solar Magnetospheric transformation matrix.
32	" "	1st row, 2nd column
33	" "	1st row, 3rd column
34	" "	2nd row, 1st column
35	" "	2nd row, 3rd column
36	" "	2nd row, 3rd column
37	" "	3rd row, 1st column
38	" "	3rd row, 2nd column
39	" "	3rd row, 3rd column
40	" "	1st row, 1st column — Geocentric Equatorial Inertial-to-Geocentric Solar Ecliptic transformation matrix.
41	" "	1st row, 2nd column
42	" "	1st row, 3rd column
43	" "	2nd row, 1st column
44	" "	2nd row, 2nd column
45	" "	2nd row, 3rd column
46	" "	3rd row, 1st column
47	" "	3rd row, 2nd column
48	" "	3rd row, 3rd column

WORD NO.	FORM	IDENTIFICATION
49	Floating Pt.	Right Ascension } Satellite position in
50	" "	Declination } celestial inertial (deg.)
51	" "	Right Ascension } Velocity vector in
52	" "	Declination } celestial inertial (deg.)
53	" "	Magnitude of the velocity (km./sec.)
54	" "	L McIlwaia parameter (earth radii)
55	" "	B Magnetic field strength (Gamma)
56	" "	B/B_o Ratio of the magnetic field strength at the satellite to the field strength at the invariant equator.
57	" "	Satellite-earth-sun- angle, Lsep (deg.)
58	" "	Satellite-earth-moon angle (deg.)
59	" "	Right ascension } Magnetic vector in
60	" "	Declination } celestial inertial (deg.)
61	" "	Longitude } Sub-solar point in (deg.)
62	" "	Latitude } Geocentric Equatorial Inertial
63	" "	GSE X } Theoretical geomagnetic field in
64	" "	GSE Y } Geocentric Solar Ecliptic coordinates
65	" "	GSE Z } (in gamma)
66	" "	Type of data item indicator: 1 = regular satellite data item 2 = ascending node crossing data item 3 = North point data item 4 = descending node data item 5 = south point data item 6 = sunlight entrance data item 7 = sunlight exit data item
67	" "	Date of data (YR MO DA)

WORD NO.	FORM	IDENTIFICATION
68	Floating Pt.	Longitude } Geodetic satellite position (deg.)
69	" "	Latitude }
70	" "	Height above spheroid (km.)
71	" "	Ascending node crossing number (pass number)
72	" "	Year of data (YR)
73-75	" "	Zero fill for spares
76	" "	Delta time between time of Ephemeris item and next previous sun pulse which stopped OA - ST Counter (Seconds).
77	" "	Spin period (Seconds)
78	" "	Right Ascension } Spin vector in celestial
79	" "	Declination } inertial (Deg.)
80	Fixed Point	Check sum of data words in words number 1 - 79
81	" "	FORTRAN record size indicator (= 000117010001_8) This indicates a total data word count of 75_{10} words.

Notes:

Longitude is positive east of Greenwich and negative west of Greenwich (-180° to + 180°)
North latitude is positive and south latitude is negative (-90° to +90°)
Date of data (word number 67) equals day + 100 (months + year (100)). Example: February 10, 1967 at 2 hours U.T. is recorded as 670210 in word 67, 41 in day count (word 1), 7200000 in milliseconds of day (word 2), and 67 in year of data (word 72).