UNIVAC 1004 SYSTEMS

MAGNETIC TAPE SYSTEM

PROVISIONAL DOCUMENT

TAPE EXECUTIVE ROUTINE (OPS)

UP 3940.12

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2. GENERAL DESCRIPTION

The Executive Routine performs three major functions:

- program loading and memory allocation;
- input/output coordination and program switching; and
- tape input/output order handling.

The source code version of the Executive Routine, found on the Master Instruction Tape (MIT) is so designed that it can be assembled in accordance with particular requirements and program options (see the assembler directive parameters of the Executive Routine, Section 3-A). Because of this, only the portions of the assembled Executive (as specified in the assembler directive parameters) absolutely necessary, are maintained in store for the worker program.

On the MIT, along with the Executive Routine source code, are a few of the more commonly used versions of the Executive in its assembled form. The particular Execution Routines provided depend upon the MIT. Two different MITs are supplied. One each for UNISERVO IIIA and UNISERVO IIIC tape units.

Immediately following the two initial load blocks on the IIIA master instruction tape are three assembled versions of the Executive in the following order:

1. 80 column, single program, with tape dump;
2. 80 column, concurrent operation, with tape dump; and
3. 90 column, single program, tape dump, with one translate table.

Following the load blocks on the IIIC master instruction tape are two assembled versions of the Executive Routine:

1. 80 column, single program, with tape dump; and
2. 80 column, concurrent program, with tape dump.

An assembled Executive Routine is loaded from the MIT in two phases. The first consists of reading data into storage under manual control. This brings in a bootstrap routine (the first program appearing on the MIT) from the tape load blocks. In the second phase, the Executive is automatically loaded by the bootstrap routine. The Executive Routine, in turn provides the ability to load worker program(s) or program segments.

Once the Executive and worker programs are loaded, the Executive Routine provides for control of such things as decimal overflow, further segment loading, orderly program stop, program release, operator request for memory dump and program jettison, error displays and recovery procedures under operator control, and program switching.

When two programs are run concurrently, the Executive Routine coordinates the exchange of control. Control is automatically passed to the other program each time one program releases control to the Executive. Control is relinquished whenever an input/output function can not be performed immediately upon request by the running program.

3. ASSEMBLING THE EXECUTIVE ROUTINE

A. ASSEMBLY OPTIONS

The Executive Routine, as available in source code on the master instructions tape, may be assembled to fit the users needs depending upon the parameters supplied in the OPS assembly directive.

OP'N	OPERANDS
OPS	p_1, p_2, p_3, p_4, p_5

p_1 is the card type

One of the following must appear as parameter one. If one of the 90 column parameters is used, a translation table is generated for 90 column card code beginning at location 01500 (octal).

= 80 for reading 80 column cards from a row or column reader, with translation.

= 90 for reading 90 column cards in object code from row or column reader, with translation.

p_2 is the tape type

= A for tape order handling and error recovery for up to six UNISERVO IIIA tape units.

= C for tape order handling and error recovery for up to six UNISERVO IIIC tape units.

p_3 is the number of programs

= CONC for the loading and concurrent running of two relocatable relative programs, or the loading and running of a single absolute program.

= SING to eliminate the portion of the Executive Routine that provides for concurrent processing (approximately 1000 characters).

p_4 is the memory dump option

= PDUMP for the inclusion of a memory print routine that can be activated by the operator (approximately 1100 characters in length).

= TDUMP to write all of memory onto tape unit 1 for future printing (the routine is approximately 65 characters in length).

p_5 specifies translation

Since all translate tables must be located in the first 4096 characters of store, the Executive Routine must set aside absolute locations for use by relocatable programs.

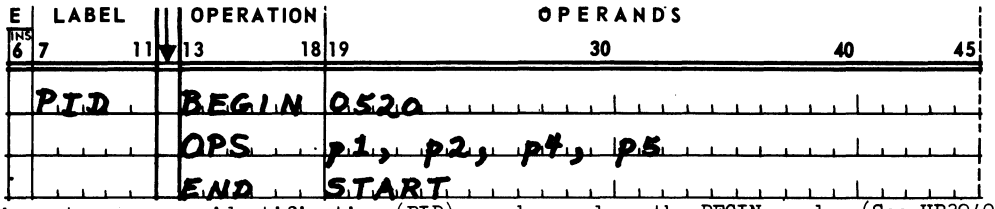
= TRNSn (where n is 1, 2, or 3) provides up to three open rows into which translate tables may be transferred.

- The 80 column version of Executive provides up to three open rows beginning at location 01500 (octal).
- The 90 column version of Executive automatically generates a translate table beginning at location 01500 (octal). This table may be used, but not disturbed, by the worker program. The open rows provided by the parameter TRNSn begin at location 01600 (octal).

Note: When running concurrent programs, translate tables should be transferred into the reserved areas as they are used since they are not preserved when program switching occurs.

B. ASSEMBLY INSTRUCTIONS

The Executive Routine may be assembled from source code found in the standard library by preparing three cards:



Any four character program identification (PID) may be used on the BEGIN card. (See UP3940.5, Section 4-A.) However, PIDs have been assigned to 10 versions of the Executive for future reference as follows:

PID	OPS Parameter Combination
OSØ1*	80, A, SING, TDMP
OSØ2*	80, A, CONC, TDMP
OSØ3*	90, A, SING, TDMP, TRNS1
OSØ4	90, A, CONC, TDMP, TRNS1
OSØ5	80, A, SING, PDMP
OSØ6	90, A, SING, PDMP, TRNS1
OSØ7†	80, C, SING, TDMP
OSØ8†	80, C, CONC, TDMP
OSØ9	90, A, CONC, PDMP, TRNS1
OS1Ø	80, A, CONC, PDMP

* These three versions are supplied on the MITs for UNISERVO IIIA tape units.

† These two versions are supplied on the MITs for UNISERVO IIIC tape units.

The standard assembly operating procedure will load the three cards, assemble the Executive Routine as specified, and place it on tape unit 1. The user may then file the assembled routine on his own instruction tape using the AJAX tape maintenance routine. The only limitation is that it must be filed at the beginning of the tape - following the initial tape load blocks.

4. LOADING THE EXECUTIVE ROUTINE

An assembled version of the Executive Routine can be loaded in one of two ways.

- Have the desired Executive Routine immediately following the initial load blocks. This can be arranged by utilizing the AJAX tape maintenance routine. Once the instruction tape is mounted on tape unit 0 and the desired Executive Routine follows the initial load blocks, it can be loaded as follows:

  a. Depress the LOAD TAPE mode button and then the PROGRAM START button.

  b. Depress the CONT mode button and then the PROGRAM START button.

  c. Upon display stop 017325, depress the PROGRAM START button.

- Advance the tape to the desired Executive Routine. (The tape must be mounted on tape unit zero.) This is accomplished as follows:

  a. Depress the LOAD TAPE mode button and then the PROGRAM START button.

  b. Depress the CONT mode button and then the PROGRAM START button.

  c. Upon display stop 017325,*

     1) depress the M button to bypass a routine. This is followed by display stop 017235. (Repeat this step until the desired Executive Routine is the next one on the master instruction tape.)

     2) depress the PROGRAM START button to load the Executive Routine. Display stop 070001 follows.

* A six digit stop display value represents only the M portion of the display. It is preceded by a 30 in the OP. portion and followed by a 60 in the C portion.

5. LOADING WORKER PROGRAMS

All versions of the Executive Routine have the ability to locate and load programs from the master instruction tape. Relative or absolute program segments may also be loaded when needed from tape. They may be loaded as described in Section 5-B, or a running program may access the Executive to load its segment without operator intervention. Relocatable segments always receive the same memory allocation and base address originally assigned the run.

A. PROGRAM CALL

The program ID may be provided by reading a call card, or by trace switch settings. A program segment ID may be provided by these same methods or by the worker program. (See Section 6-C.)

A call card used to provide a program ID must contain a $ in column one and the program ID in columns 2-5. A blank program ID from any source indicates that the next program is to be loaded from the card reader (80 column only). A program ID of ¤¤¤¤ (077777777) indicates that a load is not to be performed. If there is another program already running, the loader will return control to it through the Executive Routine.

If a program ID other than a blank or ¤¤¤¤ is received, the loader searches forward on tape unit zero for a label block (R block) containing a matching ID. If a match is not found the master instruction tape is rewound and the system stops to await further instructions. The MIT is not rewound when a program is located and loaded.

B. OPERATING INSTRUCTIONS

After the Executive Routine is loaded, the stop display 30 070001 60 indicates that the worker program is ready to be loaded (the MIT is still on tape unit 0).

To load using a call card, just depress the PROGRAM START button.

To load using trace switch settings, set the first two characters in trace switches, depress the OPERATOR REQUEST button, and then depress the PROGRAM START button. After display stop 077000, set the second two characters in trace switches, then depress the PROGRAM START button again.

To return to a program that is running without reloading, set ¤¤¤¤ in the trace switches in the same manner that a PID is set (see the preceding paragraph).

If the load being attempted is unacceptable, a list of the stop displays and procedures to be followed is contained in Section 12.

C. STORAGE ALLOCATION

Information in the R block (or card) enables the loader to determine whether or not the program will fit into available memory. In a concurrent system, where the load key (derived from the BEGIN directive) is 3, the first relocatable program is assigned the lowest storage available. The second program, loaded with a load key of 3, is assigned the highest storage available. If the load key is 5 the first program is assigned the lowest storage available and the second program is assigned the next lowest storage - after the first program. (See Section 4-A of UP 3940.5.) Storage remains allocated until the program is released or jettisoned.

Absolute programs may be loaded only if all storage is available. If an absolute program has been loaded and not released or jettisoned, no other program may be loaded.

6. PROGRAM COMMUNICATION WITH EXECUTIVE ROUTINE

The Executive Routine provides for coordination of input/output units, switching of control between concurrent programs, and tape input/output order handling. These functions are performed automatically. The following functions, however, require that the user supplies the program with the absolute locations for linkage with the Executive Routine.

A. DECIMAL OVERFLOW

A program using decimal arithmetic instructions, where the possibility of decimal overflow exists, must load the address of the overflow routine into locations 0775 - 0777. Control will be transferred to this address if a class II interrupt occurs that is not an operator request (the result of depressing the operator request button). The class III interrupt entry must not be altered at any time.

B. PROGRAM STOP

In order to bring the computer to an orderly halt, all input/output orders currently being executed must be completed and their interrupts processed. This is accomplished by a JR to the stop routine, location 0736. The Executive Routine retains control until all pending I/O interrupts have been processed.

The stop routine must be accessed before executing a JD or JHJ instruction.

C. SEGMENT LOADING

A running program may access the Executive for the purpose of loading a segment by performing the following steps in order.

1. Execute the stop routine by performing a JR to 0736.

2. Set locations 0541 (stop switch) and 0542 (call card switch) to non-blank. This will prevent the Executive Routine from stopping and reading a call card. If the segment ID is to be obtained from a call card, or trace switch setting, steps 2 and 3 are not performed.

3. Store the segment ID (four characters) in AR2.

4. If the number of the tape unit that the segment appears on is other than 0, store the appropriate unit number in location 0540.

5. When loading a segment, the contents of index registers 1 through 4 may be destroyed - they are not restored automatically. If these index registers are being used by the worker program they should be preserved before the next step.

6. Execute a JR to 0612. The proper segment will be located, loaded, and executed. Locations 0540 through 0542 are reset to blanks at the completion of the load.

D. PROGRAM RELEASE

When a program is completed, a JR to location 0700 must be executed. The Executive Routine releases storage allocated to the program and then stops. Control is not returned to the program that has been released. The release entry must not be accessed unless all processing has been completed.

E. TRACE ROUTINE

A worker program may inform the operator of a need for information to be entered from the operator console. The information may be entered into storage through the operator console trace switches when the PROC trace mode is set. The subroutine, used by the Executive Routine for this prupose, is made available to the worker program by the following steps.

1. Execute a display stop (JD) informing the operator of the need to key in two characters through the trace switches.

2. Execute a JR to 01245.

3. When control is returned to the worker program, the two characters which were set in the trace switches will be in the least significant position of AR 2.

F. SUMMARY OF LINKAGE LOCATIONS

Following is a summary of absolute locations in the Executive Routine that are available for program communication or information.

0540	Tape unit number of MIT.
0541	Executive Routine stop switch (Δ = stop; bypass stop switch (070001).
0542	Executive Routine call card switch (Δ = read a call card; 1 = bypass call card read).
0612	Load entry location - may be accessed by a JR.
0700	Program release routine entry location - may be accessed by a JR.
0736	Program stop routine entry location - may be accessed by a JR.
01000-01244	Loader read image area.
01245	Trace switch routine - may be accessed by a JR.
01302-01355	Temporary storage of tetrads 16, 17, 18, 8, and index registers 1 through 7 (in that order) of program A (the first program loaded - low order storage).
01356-01431	Temporary storage of tetrads 16, 17, 18, 8 and index registers 1 through 7 (in that order) of program B (the second program loaded - high order storage).
01432-01435	PID of the last program or segment loaded from tape.
01437-01441	Highest location of program A. Do not alter this value.
01443-01445	Lowest location of program B. Do not alter this value.
01447-01451	Highest Executive Routine location +1 (lowest location of program A). Do not alter this value.
01453-01455	Highest location in storage.
01500-01577	80 column card system: area for the first translate table generated by TRNSn in parameter 5 of the OPS directive.
01500-01577	90 column card system: input card code translate table. Subsequent translate tables, as generated by TRNSn in parameter 5, follow beginning at location 01600.

7. PROGRAM JETTISON

The jettison procedure enables an operator to release the storage allocated to a program that is unable to continue, replace it with another program, and/or continue a concurrently running program. Usually the jettison procedure is used when an unrecoverable peripheral error has occured and the program is unable to proceed to its normal conclusion and release.

To perform a program jettison,

1. Depress the OPERATOR REQUEST button to access stop display 070007.

2. While the computer is stopped, set the jettison code (see Section 12) of one of the peripheral units in the trace switches. The peripheral unit must be one of those used by the program about to be jettisoned.

3. Set the trace mode PROC button.

4. Depress the OPERATOR REQUEST button.

5. Depress the START button. The program will be released and stop display 070001 will appear. At this point any of the options listed in Section 12 for display 070007 may be exercised.

There is no program jettison procedure available in the single program versions of the Executive. If a program cannot run to a normal completion, the Executive Routine must be reloaded to substitute another program.

8. MEMORY DUMP

A. PRINT

The print memory dump feature, if included in the Executive by PDMP in parameter four of the OPS directive, will product an octal printout directly from memory and return to stop display 070007 when completed. The routine can be accessed following an operator request stop by a trace switch setting of 076. The use of the print dump option is not recommended, except for the initial stages of debugging, because of the large amount of store required by the routine.

B. TAPE

If the tape dump feature has been included in the Executive Routine, it may be accessed following the operator request display 070007 by the trace switch setting 075. A blank tape must be mounted on tape unit 1 for the first dump. All of memory is written on tape in 1024 character blocks. The computer then stops (077777) without rewinding the tape. To return to normal operation depress the PROGRAM START button. Succeeding dumps may be made without returning to the tape load point.

The TDMP routine, contained in the standard library, may be loaded by the normal call procedure in order to print the contents of memory that was dumped on unit one. The format of the printout is the same as that obtained from the Executive print memory dump.

9. PERIPHERAL ERROR RECOVERY

Each of the input/output control routines used with the Executive contains display stops to indicate the type of error that has occurred and to identify the channel and unit. To attempt recovery after a peripheral error stop, perform the following steps. (Note the exception.)

1. Depress the PROGRAM START button. If a second program is in store and it has not been affected by the error, it will continue processing. The program in which the error occurred will be by-passed until the condition is corrected. If there is no second program the Executive will loop until the operator intervenes.

2. Correct the error condition if possible.

3. Depress the OPERATOR REQUEST button to access the operator request stop 070007.

4. Depress the PROGRAM START button. If the error condition has been properly corrected the program(s) will be resumed from the point the error occurred. If not, the error stop will reappear and the procedure must be repeated. It is possible for another unit to cause an error stop display at this point without the unit that caused the previous error being retried. This is because each unit is retried in order; whether or not an attempt has been made to correct it.

Exception: The above procedure does not apply to tape errors when the single program version executive is in use. If a tape error stop display occurs, recovery is attempted automatically by depressing the PROGRAM START button.

10. PROGRAM ERROR RECOVERY

If a program error occurs that causes a loop to be entered containing no I/O processing, the Executive will not be able to secure control to process an operator request. This condition is usually apparent because the processor will be running (looping) with no I/O peripheral units operating. In order to obtain a memory dump and jettison the program,

1. Depress the PROGRAM STOP button
2. Set the top row of console switches to octal 1000072700 (octal)
3. Depress the DISPLAY/ALTER SELECTION button INST
4. Depress the ONE INSTR button
5. Depress the CLEAR button
6. Depress the ALTER button
7. Depress the START button
8. Depress the CONT button
9. Depress the START button

If the computer does not now stop at display 070007, depress the OPERATOR REQUEST button and it will. Then follow the memory dump and/or program jettison procedure. If a second program were running before the problem developed, it may now be continued.

11. OPERATOR REQUEST

Various uses of the OPERATOR REQUEST button have already been described however, some general remarks on its operation are required. The button must be lit when it is depressed in order to take effect. During the operation of the Executive or peripheral control routines there are times when the OPERATOR REQUEST button must be inhibited (light out). Sometimes this is obvious from observing the OPERATOR REQUEST button, but usually the inhibit periods are so brief that the light seems to be lit continually or to be flickering. If depressing the button has no effect, it was probably inhibited at the instant it was depressed. In that case, pause and try again.

When programs are running normally under Executive control, the OPERATOR REQUEST button is the only safe way to stop the computer without risking the loss of I/O images. Use of the PROGRAM STOP button is not recommended.

12. DISPLAY STOPS AND TRACE SWITCH SETTINGS

M Portion of Display Stops*	Explanation	Action
070001	Ready to load	Load
070002	No R card.	The load procedure must be repeated. Depress the PROGRAM START button; display stop 070001 will be accessed and the input can be corrected.
070003	Not enough storage available.	The procedure is the same as for display 070002.
070004	An attempt to load 3 programs has been made.	Same procedure as for display 070002.
070005	The card is not a call card.	Same procedure as for 070002.
070007	Program stopped by operator request.	To attempt error recovery and/or continue running, depress the PROGRAM START button. To exercise the following options at this time, depress the OPERATOR REQUEST button, set the trace mode button PROC, and enter the appropriate key in the trace switches and then depress the PROGRAM START button. Great care should be exercised in making the following trace switch settings. An incorrect key in less than 017 may cause unrecoverable problems.

Trace Switch Setting	Action
077	Load program. When program is loaded stop 070001 will be accessed.
076	Print memory. (See Section 8-A.)
075	Dump all of memory on tape unit 1. (See Section 8-B.)
00	Jettison the program that was using FASTRAND.
01	Jettison the program that was using FASTRAND.
02	Jettison the program that was using tape unit 0.
03	Jettison the program that was using tape unit 1.
04	Jettison the program that was using tape unit 2.
05	Jettison the program that was using tape unit 3.
06	Jettison the program that was using tape unit 4.
07	Jettison the program that was using tape unit 5.

*The M portion is preceded by 30 in the OP portion and followed by 60 in the C portion.

Trace Switch Setting	Action
012	Jettison the program that was using the reader on channel 1.
013	Jettison the program that was using the punch on channel 2.
014	Jettison the program that was using the printer on channel 0.
015	Jettison the program that was using channel 7.

M Portion of Display Stops	Explanation	Action
070010	Absolute program load is unacceptable (see Section 5-C)	The procedure is the same as for display stop 070002.
070104	Check sum error.	To ignore the error stop, key a 1 into location 0. (See memory alteration description.) This is not recommended unless the cause is positively known. To restart the load follow the procedure for 070002.
070105	Card or block count error.	Follow the same procedures as for 070104.
070106	Read error during load.	Depress the CLEAR button, the PROGRAM START button. The loader will return to stop 070001 and the load procedure may be repeated. NOTE: If a segment is being loaded from tape, the loader may attempt to restart the load while the MIT is rewinding. In such a case the error stop will be repeated. Wait for rewind to be completed and then repeat the procedure.
070707	PID not found on tape, possibly due to MIT positioning. The tape is rewinding.	Wait for rewind to be completed, then try again by depressing the PROGRAM START button.
070013	A 90 column card load is being attempted. (See parameter 1 of the OPS directive, Section 3-A.)	Program must be loaded from MIT.
077776	Abnormal tape condition during tape memory dump.	Rewind tape unit 1 and try again.
077777	Tape dump completed.	Depress PROGRAM START button to access stop 070007. Program(s) may be continued from this point.