THE NEW WHIRLWIND UTILITY CONTROL PROGRAM

- A Revision of the Drum Group II Program -

Richard K. Bennett
The new Utility Control Program (UCP) represents a complete revision of the DG #11 program and includes many new features. This new system should prove of great value to programmers, particularly during check-out and testing. In addition, the Utility System may be used by a program to perform any of its functions.

Section A presents the essentials of the new system, and it should be read by all WWI users. Section B covers the more elaborate features, which would be of interest to the more serious user. Section C describes the categories.

The Appendix contains a summary of the categories, the MIR configurations, the LMIR Digit values, the error codes, and the Index.
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Utility System Categories
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A. ESSENTIALS

The reader is assumed familiar with the basic concepts of the Utility System as outlined in DCL-22, Utility Control Program. Reference is also made to 2M-0277, Whirlwind Programming Manual.

The new Utility Control Program (UCP) is controlled by the Manual Intervention Registers (MIR's) essentially as was the old. Basically, the Category Number of the requested action is punched in Digits 4 and 5 of the Right MIR (RMIR), and the Read-In (RI) button is pressed. The Generalized Post-Mortem program is selected as before -- by setting the desired mode in Digits Sign (S) and 1 of the RMIR.

There are a few changes which should be noted at the outset.

1. "Examine" Button

It is no longer necessary to press the Right Activate Button to cause the UCP to "examine" the RMIR. Instead, the RMIR will always be examined when the RI button is pressed. Therefore, the operator must keep the MIR's set at zero, for normal read-ins.

2. Flip-Flops

The FF's should be in their numerical sequence.
(This is not actually required by the UCP at present, however.)

3. Toggle Switches

The toggle switches in Test Storage should be set as listed below. The locations are given first in decimal, then in octal.

<table>
<thead>
<tr>
<th>Octal</th>
<th>Entry</th>
</tr>
</thead>
<tbody>
<tr>
<td>7/0.50002</td>
<td>ta 2</td>
</tr>
<tr>
<td>8/0.34320</td>
<td>cf 320</td>
</tr>
<tr>
<td>9/0.77777</td>
<td>sp 3777</td>
</tr>
</tbody>
</table>
3. **Toggle Switches (Cont.)**

<table>
<thead>
<tr>
<th>Octal</th>
<th>Entry</th>
</tr>
</thead>
<tbody>
<tr>
<td>19/0.14062</td>
<td>23  UCP without cores to DG #0</td>
</tr>
<tr>
<td>20/0.40024</td>
<td>24</td>
</tr>
<tr>
<td>21/0.33741</td>
<td>25</td>
</tr>
<tr>
<td>22/1.00023 ca 23</td>
<td>26  UCP without cores to DG #0</td>
</tr>
<tr>
<td>23/1.14024 su 24</td>
<td>27  Drum Group (DG) #7 Block-In</td>
</tr>
<tr>
<td>24/0.74036 sp 36</td>
<td>30</td>
</tr>
<tr>
<td>25/0.50003 ta 3</td>
<td>31  UCP, Program use</td>
</tr>
<tr>
<td>26/1.00032 ca 32</td>
<td>32  UCP, RI</td>
</tr>
<tr>
<td>27/0.00707 si 707</td>
<td>33</td>
</tr>
<tr>
<td>28/0.20032 bo 32</td>
<td>34</td>
</tr>
<tr>
<td>29/1.14025 su 25</td>
<td>35  DG #9 Block-In</td>
</tr>
<tr>
<td>30/0.00703 si 703</td>
<td>36</td>
</tr>
<tr>
<td>31/0.10036 bi 36</td>
<td>37</td>
</tr>
</tbody>
</table>

4. **ck - Order Switch**

The ck-order switch should be set for its new (special) mode.

5. **Magnetic Tape Read-In**

Read-in from magnetic tape is not accomplished by placing the block number in the RMIR, as it was in the past. Instead, Category 64 would be used for this function.

6. **Interlock**

An "interlock" feature has been added to help prevent the destruction of one program by another. This Interlock is described in the next section, but suffice it to say at this point, that it can be cleared by selecting Category 16, with 1.00077 in the Left MIR (LMIR).
7. Log Suppression

Logging may be suppressed in the new system. If logging is desired, this suppression can be cleared by selecting Category 12, with 1.00001 in the LMIR, which logs the Time and Date on the direct Flexo.

8. CS II STOP

The former CS II STOP order will not work with the new system.

9. Director Tapes

The Director Tape system has been removed from the new system. It may effectively be replaced by the Master Program concept (see Section B).

10. Scope Post-Mortem

The Scope Post-Mortem program (formerly Category 44) has been dropped from the new system. However, the Generalized Post-Mortem program will still provide scope output, if desired.

11. Scope Log

Scope logging has been removed. It will, therefore, be necessary to record the frame numbers to identify film output.

12. Read-In

"Automatic" read-in (Categories 00 and 01) will recognize only fb, fc, and fp tapes. Binary tapes without fb titles may be read-in by Category 23. All other tapes will not be accommodated.

13. Buffer Drum Storage

Registers 3740 - 3777 of Buffer Drum (BD) 7 are reserved for the UCP. Programmers should take care not to disturb this area.
If the user takes note of the above points, he may use the new UCP as he has the old. He would be well advised, however, to study the following sections of this memo, in order to take advantage of the new facilities of the Utility System.

14. Stop on si 11 or 12

The Console switch should be set so that si 11 or 12 causes a halt rather than re-setting the Clock. If this convention is followed, the Time and Date will remain valid indefinitely (as long as the UCP is used at least once every nine hours).
B. FEATURES

The features and characteristics of the new UCP are discussed below.

1. Pattern

The pattern 1.25252 (1.010 101 010 101 010) is stored in FF 6, when the UCP is in memory. This pattern will help to indicate whether the UCP or the normal contents of core is in core memory.

2. Logging

A fairly extensive log is available in the new UCP. All categories are logged by a three-letter mnemonic code. The time is logged for all requests and, in addition, the date is logged when tapes are read-in. Complete fc and fb titles are logged, including the fb titles on magnetic tape. Also, for binary tapes, the areas read into are logged.

The entire logging, or just the area log, may be suppressed by Category 13.

3. Error Behavior

Detected errors will cause a halt in register zero, after logging and restoring Core Memory. The code "err" is printed, followed by a three-letter mnemonic code describing the type of error. The error codes are listed in the Appendix.

4. Program Entry to UCP

The Utility System may be used by a program to perform one of the available functions. Program entry to the UCP is by an "sp 31" (octal) or an "sp 32". The sp 32 entry behaves as it has in the past in that it selects Category 00, unless either the Left or Right Activate Bits are set, in which case the MIR's are interpreted.
For the sp 31 entry, the sp 31 instruction is followed by two program parameters representing the LMIR and RMIR, respectively. The UCP will execute the requested function and return control to the calling program at the register following the one representing the RMIR.

Program entry to the UCP may be used by a programmer to augment his program with the facilities of the Utility System. He may thus clear a drum group, block in a program (to other core fields), tag his print-out with the time and date, call for a memory dump or post-mortem print, etc.

Alternately, the program entry to the UCP may be used to manipulate tapes and programs in a manner similar to an operator. Thus, this feature may be used to replace the old Director Tape system. The only problem with this type of operation occurs when the Start-At Category is requested. This problem is solved by the Master Program concept.

5. Master Program

When a program, acting in the place of a Director Tape, requests the Start-At Category, it is defined as a Master Program. The program thus operated (started) by the Master Program may then itself use the UCP (as discussed above) without causing confusion over the return point. If the operated program is terminated by the UCP request, Start-At Zero (interpreted as "Stop"), the UCP will then return control to the Master Program.

Thus, a Master Program may read in, manipulate, and operate a sequence or system of programs. Programmers interested in this facility should end their programs with

```
sp 31
0
7
```

which is literally "Start-at zero", but is interpreted as "Stop". This is equivalent to the former CS II "STOP" in its effect. (The STOP order is translated by the CS II Conversion Program as "sp 31", which is no longer valid unless followed by 0 and 7, as above.)
In addition to the above, a "Stop" will cause the Return Address and Core Fields (that is, the location of the register following the 7) to be stored as the Starting Address for possible later use. A Master Program could then "restart" a program, or a Checker run could be initiated.

A Master Program definition is cancelled by either a program return (Stop) or by a manual pressing of either the RI Button or one of the Activate Buttons. If there is no Master Program defined at the time of execution of a "Stop", the UCP will halt in register zero. Pressing the Restart (RS) Button (twice if the s1 Switch is ON) will resume operation of the program.

6. Ignored Characters

The following Flexo characters are ignored before the b, c, or p of fb, fc, and fp tapes. This feature will provide greater freedom in preparing and slicing paper tapes.

00 Blank Tape
05 Slash
10 Space
20 Color
43 Back Space
45 Tabulation
51 Carriage Return
61 Stop
71 Upper Case
75 Lower Case
77 Nullify

The above specification applies only to the first fc title on a Conversion. Subsequent fc titles, including those at the beginning of dependent tapes in a Combined Conversion, are read and interpreted by the Conversion Program, and hence the usual rules for ignored characters would apply.

It should be remembered that the Conversion Program accepts fc as a control word introducing a title, which may appear anywhere within a program. Since dependent tapes of a Combined Conversion are treated as an extension of the first tape, the fc title is treated as occurring in the middle of the program and, in fact, is not necessary for the Conversion. Incidentally, such internal fc titles are ignored.
7. Control Words

The Binary Input Program of the UCP recognizes the following Control Words. This list represents an increase over those previously available.

0.00000 - 0.00012 Drum Group Override: The specified Drum Group will be substituted in all future DA's on that tape.

0.00013 - 0.00037 Spare - Illegal

0.00040 - 0.53777 DA (Aux. Drum). This word introduces a Program Block (a block of words)

0.54000 ck 0: A Check-Sum Control Word; either ck 5 or ck 7, must occur after each Block on the tape.

0.54001 ck 1: Cancel a previous ck 0 Control Word request.

0.54002 Spare - Ignored at present

0.54003 Do Nothing (i.e., ignore this Control Word.)

0.54004 Spare - Ignored at present

0.54005 ck 5: A Check-Sum for the preceding Program Block, including the DA Control Word, is stored in the register following.

0.54006 Spare - Treated same as ck 7, at present

0.54007 ck 7: Like ck 5, but ignore the Check Sum in the following register.

0.54010 - 0.54277 Spare - Illegal

0.54300 - 0.54377 ck 3b: Change fields to (a, b). (Certain values of ab are illegal.) This Control Word is repeated for verification purposes.

0.54400 - 0.54477 ck 400; d. Erase drum group d. (Add 20 to mean DD). (Certain values of d are illegal.) This Control Word is repeated for verification purposes.

0.54500 - 0.54777 Spare - Illegal

0.55000 ck 1000: Ignore the next Program Block (Literally, Ditto 0)

0.55001 ck 1001: Literally, Ditto 1. This Control Word has no effect

0.55002 - 0.56000 ck 1000 + M: Ditto m: Repeat the next block m times.

0.56001 - 0.67077 Spare - Illegal

0.67100 - 0.67177 fb Title
7. Control Words (Continued)

<table>
<thead>
<tr>
<th>Decimal</th>
<th>Hexadecimal</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.67200 - 0.73777</td>
<td>0.00000 - 0.0155</td>
<td>Spare - Illegal</td>
</tr>
<tr>
<td>0.74000 - 0.74002</td>
<td>0.0155 - 0.017F</td>
<td>sp 0, 1, 2: Store contents of register following in FF 2, and sp 0, 1, 2.</td>
</tr>
<tr>
<td>0.74003 - 0.74007</td>
<td>0.017F - 0.017F</td>
<td>sp 3-7: Ignore this and following word.</td>
</tr>
<tr>
<td>0.74010 - 0.77777</td>
<td>0.017F - 0.017F</td>
<td>Spare - Ignore this and following word, at present.</td>
</tr>
<tr>
<td>1.00000</td>
<td>0.00000 - 0.00000</td>
<td>ca 0: End of information on a card or block.</td>
</tr>
<tr>
<td>1.00001 - 1.00006</td>
<td>0.00000 - 0.003</td>
<td>Spare - Treated as ca n, at present.</td>
</tr>
<tr>
<td>1.00007 - 1.00777</td>
<td>0.0030 - 0.0077</td>
<td>ca n: Magnetic Tape Record Number n (Used only on Magnetic Tapes)</td>
</tr>
<tr>
<td>1.01000 - 1.07777</td>
<td>0.0078 - 0.0077</td>
<td>DA (Buffer Drum). Introduces a Program Block.</td>
</tr>
<tr>
<td>1.10000 - 1.37777</td>
<td>0.0078 - 0.0077</td>
<td>Spare - Illegal.</td>
</tr>
<tr>
<td>1.40000 - 1.76777</td>
<td>0.0078 - 0.0077</td>
<td>Spare - Illegal.</td>
</tr>
<tr>
<td>1.77000 - 1.77777</td>
<td>0.0078 - 0.0077</td>
<td>-n + 1: Number of words in the next Program Block (which follows the next DA) is n.</td>
</tr>
</tbody>
</table>

The maximum block length is 1000 octal, except blocks preceded by a DITTO m Control Word, in which case the product of m and n must not exceed 1000.

The ck 0 Control Word is a new feature designed to "tighten up" the sum-checking of a binary tape. The problem is that in the old system a check-sum was not required by the UCP. Therefore, if the -n+1 Control Word were incorrect, the check-sum might be missed during read-in, and consequently an error could go undetected.

In the new UCP, a check-sum is expected after a Program Block, for read-in from magnetic tape. However, for paper tapes, since manual modification is permissible, the ck 0 Control Word indicates that the tape must have check-sums. To make a manual modification, a ck 0 may be changed to a ck 1, or a ck 1 added, to cancel the check-sum requirement.

The ck 3ab Control Word switches the designated core fields to the A and E positions. The ck 400+d Control Word erases the indicated Drum Group. These Control Words may be inserted on a binary tape by hand, or by the Conversion or Magnetic Tape Loading Programs -- if future modifications are made.
8. Interlock

The Interlock is provided to protect one program from destruction by another. It consists of 16 bits -- one for each of the available AD and BD groups (AD #0 is not represented). The Interlock may be set manually, by Category 16, or automatically, by specifying the desired Interlock Control in Digit 1 of the LMIR, when performing any of the available read-in categories (00, 01, 23, 63, 64).

The Interlock Control may also be used to select the desired behavior with respect to obeying the Interlock during read-in -- i.e., not reading into a "locked" drum group.

9. Room 222 Control

The UCP may be controlled from Room 222 by placing 222 in the RMIR of Test Control. Category selection may then be made on the MIR's in Room 222 in the same manner as for Test Control, except that it will be necessary to press the "Examine" and/or "Erase" Activate Buttons, before starting at 32.

More precisely, Room 222 control is initiated if the RMIR in Test Control is set to "222", either Activate Button in Room 222 is set and neither Activate in Test Control is set. Room 222 control is terminated by pressing RI or either Activate Button in Test Control.

10. Magnetic Tape Format

In addition to the old format for magnetic tape, the new UCP accommodates a format where several blocks may each have the same number and where the title block precedes only the first block of such a group of blocks. This array of one title block and several identically-numbered following blocks is termed a Record. A block is the old format, together with its preceding title block, is a special case of a Record.
This new system -- which, of course, will not be implemented until a new magnetic tape loading program is written -- will permit arbitrary-length Records. The Record Number, therefore, would be associated with a program, as desired, independent of the length of the program.

11. **Switch Fields**

Digits 2 and 3 of the RMIR are interpreted as "Switch Core Fields" for all categories, if these Digits are other than 00. The switching takes place before the category is performed.

After the category is completed, the UCP halts in register 0. Except for special cases (such as Examine and Insert and the Read-In categories), RS* will re-enter the UCP to select another category in the new core fields. The use of RS instead of RI is to avoid the resetting of the core fields, which occurs with the RI Button.

This Switch Fields feature permits the programmer to control the core fields with the octal buttons on the console, as opposed to using the binary Core Field Reset Switches.

12. **Start-Over at 26**

The UCP may be entered, without first storing Core Memory on DG #0, by a Start-Over at 26 (octal). This feature avoids the destruction of the Core Image on DG #0, if the UCP or other Utility Program is in core memory.

13. **Address Display**

The Starting Address following a read-in is displayed in the Indicator Lights.

* The RS Button must be pressed twice if the si 1 Switch is ON.
14. **Magnetic Tape Display**

Whenever magnetic tape is searched, the Record Number selected is displayed in FF 2, and the current Record Number being scanned, in FF 3.

15. **Binary Input Display**

During the read-in of a binary tape, the current $-n+1$ Control Word is displayed in FF 2, and any other Control Word (generally a DA), in FF 3.

16. **Erase**

The Left Activate Button is interpreted as "Erase Operating Core Memory" before the execution of Categories 00, 01, 23, 24, 25, 30, 40, 50, 60, 64, and 71. These are the Categories which involve the reading in of a program.
C. CATEGORIES

The categories are described below, in the order of their Category Number. For each, the logging code is given. The Digits listed at the end of the descriptions refer to the LMIR. The values for the Digits are interpreted in the Appendix.

The Sign Digit of the LMIR, when used alone, is called the "L-Modifier". The setting 0.1 of the Sign Digit and Digit 1 of the RMIR is called the "R-Modifier."

00 Read-In (Automatic)

Automatic read-in is performed for fb, fc, and fp paper tapes. The Binary Input Program handles an fb tape, whereas the Conversion Program or the Generalized Post-Mortem Program (both Drum Utility Programs) are brought in by the UCP for an fc or an fp tape, respectively.

For an fb or fc tape, the Starting Address and Core Fields are stored for possible later use.

In place of the three-letter code, the Date will be logged, for this Category.

R-Modifier: Suppress Flags
Digit 1: Interlock control
2: Magnetic Tape Unit
3: Number of Dependent Tapes for a Conversion. (The value 0, means stop on first after first pass)
4: Input Unit (any)
5: Output Unit (Delayed Flexo is assumed, unless Direct Flexo is selected.)

01 'pbt/oth' Read-In, Special Action

Read-in is performed in the same manner as for Category 00, except if the input is an fc tape, an fb tape is punched ("pbt"); if the input is an fp tape, the tape is stored on the Buffer Drum for later use ("oth"). The punch is delayed, unless the Direct Flexo is selected.
02 "examine" Examine and Insert

Any register in Drum or Core Memory may be examined and its contents changed, if desired. The operation is completely logged, in addition to the display of the contents in the Indicator Lights.

Once selected, this category will permit an unlimited number of examinations and insertions in any combination, under control of the RS Button.* Core Memory is restored before each halt, so that operation may be discontinued safely at any time.

An examination is performed by setting the Drum Address (DA) in the LMIR. After the initial use of RI, the RS Button* is used to execute the operation. The same register may not be examined twice in a row, since this would result in an insertion, as described below.

An insertion is obtained subsequent to an examination by leaving the LMIR (DA) unchanged and setting the desired contents in the RMIR. The operation is initiated by RS.* Several insertions may be made in the same register by leaving the LMIR unchanged.

Thus, the rule is that if the LMIR (DA) is changed, an examination is made; if it is unchanged, the contents of the RMIR are inserted in the selected register. The RS Button* is used for both cases.

03 "wsc" Write Stop Character

A Lower Case, Carriage Return and Stop combination is recorded twice on the delayed printer.

* If the s1 Switch is ON, the RS Button must be pressed twice (since the halt occurs in register 0).
04 "erd" Erase Drums

This Category would erase the drum group specified in the LMR. Since an error in this Category could have devastating effects on a program, for the case of manual entry to UCP, a halt would occur after logging the drum group (in decimal) to be erased. RS would consummate the erasure and log "did", or RI would re-select the Category, if a change were desired. Example

erd ad 8 did

Digit 3: 0 - AD
        1 - BD

Digits 4, 5: Drum Group Number. DG #77 means erase all groups of the selected drum.

05 "gpm" PAPM

A PAPM on the selected printer is performed.

Digit 2: Magnetic Tape Unit

Digit 5: Output Unit (Delayed Flexo is assumed, unless Direct Flexo is specified.)

06 "dmp" Memory Dump

A Memory Dump of any Core Memory or Drum Group is obtained in a combination of octal fraction and order code. The initial address is inserted in the LMR, with the least significant octal digit replaced by the output unit selection. Core Fields (00 means operating cores)

The entire Drum Group is printed, unless interrupted by pressing the Right Activate Button, in which case printing ceases and Core Memory is restored. The DA of the line being printed is displayed in FF-2. Indicator lights
Identical lines are suppressed, except that the first and last lines of the block are printed. A blank line is provided to signal the missing lines.

Digits 3: Initial DA

Digit 4 or 5: Output Unit (any)

07 "sta" Start-At

This Category sets up a Starting Address and/or initiates the operation of a program in Core Memory.

If a Starting Address is given in the LMIR, it is treated in the same manner as the Starting Address of an fb or fc tape. The Starting Address and Core Fields are stored for possible later use, and a halt on si 1 occurs before operating the program.

If the L-Modifier is set, the Starting Address and Core Fields last stored are used, and operation of the program commences immediately.

A starting address of zero would mean "Stop" (for the purpose of returning to a Master Program). In this case, the Return Address and Core Fields would be stored as the Starting Address for possible later use.

If a Master Program had been defined at the time of execution of a Stop, the UCP would return control to the Master Program. Otherwise, the UCP would halt at zero, in which case RS (twice if si 1 Switch is ON) would continue the operation of the program.

L-Modifier: Use the Starting Address and Core Fields last stored

Digits 2-5: Starting Address
12 "log" Log Time and Date

The Time and Date are logged on the selected printer.

The Log Suppression is cleared if the L-Modifier is set.

L-Modifier: Continue future logging on the selected printer and clear Log Suppression

Digit 5: Output Unit (any)

13 "nlg" No Log

Logging is Suppressed.

L-Modifier: Suppress only the Area Log

16 "lck" Set Interlock

Selected Interlock bits are set or cleared. The contents of the Interlock are logged before the change, as an octal fraction. (The bit assignment to drum groups is given in the Appendix.)

The change is logged as an octal fraction preceded by a plus or minus sign, according to whether the bit is set or cleared. The final contents of the Interlock are interpreted and logged.

For example, if AD 2 is locked and BD 3 is selected to be locked, the log would appear

\[ lck 0.00000 +0.00020 AD 2 BD 3 \]

If the LMIR is set to zero, the Interlock is logged without change.

L-Modifier: Clear selected bits

Digit 3: 0 - AD
         1 - BD

Digits 4, 5: Drum Group Number. 77 means all bits.
22 "ckr" Checker

The Checker is a Drum Utility Program, described in Memo LW-10. The inclusion of the Checker in the Utility System has resulted in improved facilities, among which are certain selections which may be made via the LMIR in lieu of an Executive Tape.

L-Modifier: 0 - Start at 40
1 - Use Starting Address and Core Fields last stored

Digit 1: Areas
-If pm request:
  0 - Operating Cores
  1 - All Cores*
  2 - All Cores and AD
  3 - All Cores, AD, and BD
-If Interested Area Mode
  0 - 40 - 3777
  1 - 40 - 1777
  2 - 2000 - 3777
  3 - 40 - 777
  4 - 1000 - 1777
  5 - 2000 - 2777
  6 - 3000 - 3777
  7 - Zero area: Just print jumps

Digit 2: Magnetic Tape Unit

Digit 3: Mode
  0 - Direct
  1 - Trace
  2 - Changed Register
  3 - Interested Area: Store-type Instructions
  4 - Interested Area: Employ-type Instructions
  5 - Interested Area: Both types of Instructions

Digit 4: Request
  0 - Read Executive Tape
  1 - pm
  2 - cm
  3 - Set mode and start
  4 - pm, Start (direct mode), cm
  5 - Use Executive Program previously stored at 1.1000

Digit 5: Output Unit (Anelex, Direct or Delayed Flexo)

* Except CFO which is used by the Checker
23 “bri” Binary Read-In

A binary tape without an fb title is read in according to the conventions of Category 00.

24 “cri” Card Read-In

Binary cards are read in as for Category 23. The standard Utility System conventions apply to binary cards. However, since cards are a discontinuous medium, it is necessary to specify how information may be terminated on a card, before the end of the card.

The Control Words, which indicate an end of information on a card are ca 0, ck3ab (change core fields), ck 400+d (erase drums), ck 1000+m (Ditto) followed by a Program Block, and sp 0, 1, 2 followed by sp x.

25 “dri” Direct Read-In

A special binary input program is placed at the end of Core Memory, beyond 3700. This program reads in binary tapes having only Ch+1, core DA, ck 5, and sp 1 or 2 Control Words.

This category permits reading into core directly, as opposed to reading into DG #0. The core image on DG #0 is thus preserved. After the operation of a program thus read in, entry at 26 (o) permits UCP entry without destroying the Core Image on DG #0.

30 Drum Checker

The Drum Checker is a Utility Program which is read from magnetic tape to core (image).
33 "gpm" Execute fp-Tape

The Generalized Post-Mortem Program is called to execute the last fp tape stored on the Buffer Drum.

Digit 2: Magnetic Tape Unit

40 Magnetic Tape Checker

The Magnetic Tape Checker is a Utility Program which is read from magnetic tape to core (image).

Digit 2: Magnetic Tape Unit

44 "dtd" Drum to Drum Transfer

The contents of one drum group are transferred to another, as specified in the LMRIR. On manual entry, a halt occurs, as for Category 04. Example

dtd ad 3 to bd 4 did

Digit 0: 0 - AD
1 - BD

Digits 1, 2: Drum Group, From

Digit 3: 0 - AD
1 - BD

Digits 4, 5: Drum Group, To

50 Scope Calibration

The Scope Calibration is a Utility Program which is read from magnetic tape to core (image).

Digit 2: Magnetic Tape Unit
55 "ppp" Program Print Program

The Program Print Program is now a Drum Utility Program. It has been described in Memo 2M-0626.

Digit 2: Magnetic Tape Unit

Digit 3: Number of Dependent Tapes (0 means single tape)

Digit 5: Output Unit (Anelex, Direct Flexo, Delayed Flexo, Delayed Punch, Direct Punch)

60 PETR Check

The PETR Check is a Utility Program which is read from magnetic tape to core (image).

Digit 2: Magnetic Tape Unit

62 "sup" Form Check-Sum for Drum Utility Program

The specs for this Category are unchanged. A check-sum for the Drum Utility Program specified in the LMIR would be formed and stored in its proper place on the drums.

Digit 5: Drum Utility Program Number

63 "rup" Read-In Drum Utility Program

The Drum Utility Program, specified in the LMIR, is read from the magnetic tape unit specified to the proper drum location.

The code for the Drum Utility Program is logged after the code for the category. For example

\[ \text{rup-gpm} \]

1. Modifier: Read-in only if not in drum

Digit 1: Interlock Control

Digit 2: Magnetic Tape Unit

Digit 5: Drum Utility Program Number
64 "rmt" Read Program from Magnetic Tape

A program is read from the selected Magnetic Tape, starting with the Record Number in the LMIR, until an sp-Control Word, which is not sp 32 (0). If the l-Modifier is set, only the first Record is read.

After positioning the tape a Halt on si 1 is executed.

l-Modifier: Read only one Record

Digit 1: Interlock Control

Digit 2: Magnetic Tape Unit

Digits 3-5: Record Number

65 Magnetic Tape Copy

This Category is reserved for future use by a Magnetic Tape Copy Program

66 Magnetic Tape Record Formation

This Category is reserved for future use by a program to form Magnetic Tape Records from Drum and Core Memory.

71 Test Storage Check

The Test Storage Check is a Utility Program which is read from magnetic tape to core (image).

Digit 2: Magnetic Tape Unit

76 "set" Set Time and Date

This program is read from magnetic tape directly to core memory (without disturbing core image on DC #0). The Time and Date are set, as in the old system.

Once set, the Time and Date will be corrected, as long as the UCP is entered at least once every nine hours. The Date is properly handled, even for leap years.
The Time is first set in the LMIR. A halt occurs. (In this case, Core Memory is not restored.) The Date is then set and the RS Button pressed.

**TIME**

Digit S: 5 Minute

Digits 1, 2: Hours, 0-27 (octal)

Digit 3: Tens of Minutes

Digits 4, 5: Units of Minutes 0-11 (octal)

**DATE**

Digits S, 1: Month, 1-14 (octal)

Digits 2, 3: Days, 1-37 (octal)

Digits 4, 5: Years beyond 1950

77 "nop" No Operation

The Activate Bits are cleared and core fields are switched, if requested. However, no specific function is selected.

On program entry, a second request is executed. The MIR's for the second request should follow those for the 77 request, without an intervening sp 31. This feature permits a Post-Mortem Request in other core fields.
### Utility System Categories

<table>
<thead>
<tr>
<th>No.</th>
<th>Code</th>
<th>Title</th>
<th>LMIR</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>(Date)</td>
<td>Read-In</td>
<td>A</td>
</tr>
<tr>
<td>01</td>
<td>ptk</td>
<td>If fc Tape, Punch Binary Tape</td>
<td>A</td>
</tr>
<tr>
<td>02</td>
<td>exm</td>
<td>Examine</td>
<td></td>
</tr>
<tr>
<td>03</td>
<td>wst</td>
<td>Write stop Character</td>
<td></td>
</tr>
<tr>
<td>04</td>
<td>erd</td>
<td>Execute Drums</td>
<td></td>
</tr>
<tr>
<td>05</td>
<td>gpm</td>
<td>PAPM</td>
<td>C</td>
</tr>
<tr>
<td>06</td>
<td>dmp</td>
<td>Memory Dump</td>
<td></td>
</tr>
<tr>
<td>07</td>
<td>sta</td>
<td>Start-at</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>log</td>
<td>Log Time and Date</td>
<td>A</td>
</tr>
<tr>
<td>13</td>
<td>nig</td>
<td>No Log</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>lk</td>
<td>Set Interlock</td>
<td>D</td>
</tr>
<tr>
<td>22</td>
<td>ckr</td>
<td>Checker (See separate memo)</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>bri</td>
<td>Binary Read-In</td>
<td>A</td>
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<td>24</td>
<td>cri</td>
<td>Card Read-In</td>
<td>A</td>
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<td>25</td>
<td>dri</td>
<td>Direct Read-In</td>
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<td>30</td>
<td>mtp</td>
<td>Drum Checker</td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>gpm</td>
<td>Execute fp-Tape</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>mtp</td>
<td>Magnetic Tape Checker</td>
<td></td>
</tr>
<tr>
<td>44</td>
<td>ddd</td>
<td>Drum to Drum Transfer</td>
<td>D</td>
</tr>
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<td>50</td>
<td>mtp</td>
<td>Scope Calibration</td>
<td></td>
</tr>
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<td>55</td>
<td>ppp</td>
<td>Program Print Program</td>
<td>A</td>
</tr>
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<td>60</td>
<td>mtp</td>
<td>PETR Check</td>
<td></td>
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<tr>
<td>62</td>
<td>sup</td>
<td>Form Check-sum for Drum Utility Program</td>
<td>B</td>
</tr>
<tr>
<td>63</td>
<td>rup</td>
<td>Read-In Drum Utility Program</td>
<td>B</td>
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<tr>
<td>64</td>
<td>rmp</td>
<td>Read Program from Magnetic Tape</td>
<td>B</td>
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<tr>
<td>65</td>
<td>mtp</td>
<td>Magnetic Tape Copy</td>
<td></td>
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<tr>
<td>66</td>
<td>mtp</td>
<td>Magnetic Tape Record Formation</td>
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<td>71</td>
<td>mtp</td>
<td>Test Storage Check</td>
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</tr>
<tr>
<td>76</td>
<td>set</td>
<td>Set Time and Date</td>
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</tr>
<tr>
<td>77</td>
<td>nop</td>
<td>No Operation</td>
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## RMIR CONFIGURATION

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<tr>
<th>S</th>
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<th>2</th>
<th>3</th>
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<th>5</th>
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<tbody>
<tr>
<td></td>
<td>Core Field</td>
<td>Core Field</td>
<td>Category Number</td>
<td>a magnetic tape block No. (over III)</td>
<td></td>
</tr>
<tr>
<td>Generalized Post-Mortem Selection except 0, 1, which is the R-Modifier.</td>
<td>Switch Fields (do not switch fields)</td>
<td></td>
<td></td>
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## LMIR - "A" CONFIGURATION

For Categories: 00, 01, 05, 12, 23, 55

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<th>5</th>
</tr>
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<tbody>
<tr>
<td>Modifier</td>
<td>Interlock</td>
<td>Magnetic Tape Unit</td>
<td>Number of Dependent Tapes</td>
<td>Input Unit</td>
<td>Output Unit</td>
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## LMIR - "B" CONFIGURATION

For Categories: 62, 63, 64

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</tr>
</thead>
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<tr>
<td>Modifier</td>
<td>Interlock</td>
<td>Magnetic Tape Unit</td>
<td>Tape Record Number or Drum Utility Program</td>
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**LMIR - "C" CONFIGURATION**

For Category 06

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<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>DA (to even octal 10) for Dump</td>
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**LMIR - "D" CONFIGURATION**

For Categories: 04, 16, 44

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<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>&quot;From&quot; Drum Group</td>
<td>&quot;To&quot; Drum Group</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>&quot;Erase&quot; Drum Group</td>
<td>&quot;Lock&quot; Drum Group</td>
</tr>
</tbody>
</table>

**LMIR - "E" CONFIGURATION**

For Category 07

<table>
<thead>
<tr>
<th>S</th>
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<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Core Memory Address</td>
</tr>
</tbody>
</table>
OCTAL CODES FOR LMIR DIGITS

Interlock Control - Digit 1

0 - **Obey Interlock.** If the Interlock were set for a drum group specified by an fb tape, the read-in would stop on an error halt. The area covered by the attempted read-in would be logged. For Example

```
1.10400 - 1.10477 lkt
```

1 - **Read-in blocks addressed to unlocked groups:** Ignore blocks addressed to locked groups. Ignored blocks would be logged, for example

```
1.04022 - 1.04100 ign
```

2 - **Override Interlock.** Read-in would proceed, ignoring the Interlock.

3 - **Reset Interlock.** First, the Interlock would be cleared by automatically executing a Category 16 request to clear all bits. Then, read-in would proceed as for the (0) case.

4-7 - **Set Interlock after read-in.** By adding 4 to the above values for Digit 1, the Interlock is automatically set after read-in according to the drum groups affected.

The behavior during read-in is governed by the selection from the above four cases. Logging would be similar to that for Category 16.

The above descriptions apply to fb tapes. Digit 1 does not apply to the read-in of fp tapes. Digit 1 does, however, apply to fc tapes, but in a special sense.

If Digit 1 is 0 or 1, read-in of an fc tape would be inhibited, if any AD bit of the Interlock were set. In such a case, "lkt" would be logged.

If Digit 1 is 2 or 3, fc tapes would override the Interlock. Values of 4-7 for Digit 1 would be considered illegal for fc tapes.
For an fc or fp tape, the UCP checks if the corresponding Drum Utility Program (the Conversion or GPM Program) is on the drum. If it is not, the UCP would execute an automatic Category 63 request to read in the Drum Utility Program, using the (0) Interlock Control. (If the Interlock is set for the drum groups used by the Drum Utility Program, the read-in would halt.)

Magnetic Tape Unit - Digit 2

For those Categories which call for reading a program from magnetic tape, Digit 2 selects the desired unit. Since the Utility Programs are stored on MT 0, Digit 2 should normally be zero.

Number of Dependent Tapes - Digit 3

This Digit has two similar uses. For Categories 00 and 01, it refers to the number of fc tapes in an "automatic" Combined Conversion. (These tapes must be spliced together, since no halt will occur between them.) If this Digit is set to zero, a halt on si 1 will occur after the first pass of the Conversion, in which case RS will complete the Conversion, or SA 40 will read-in another tape for a "manual" Combined Conversion.

For Category 55, "ppp", Digit 3 refers to the number of dependent fc tapes to be listed. In this case, the value zero carries the same meaning as the value one. If more than one tape is indicated, a halt on si 1 is executed, for manual UCP entry, between each tape. The Program Print Program will treat subsequent tapes as extensions of the original tape, except that the first two lines of each will be copied as a "title".

Input Device - Digit 4

0 - PTPR
1 - MTR
2 - Keyboard
3 - MTR, Rm. 222
Output Device - Digit 5

0 - Analex
1 - Direct Flexo
2 - Delayed Flexo
3 - Delayed Punch
4 - Direct Punch
5 - Spare
6 - Rm. 222 Flexo
7 - Rm. 222 Punch

Drum Utility Program - Digit 5

0 - "gpm" Generalized Post-Mortem
1 - "ppp" Program Print Program
2 - "cnv" Conversion Program (CS II)
3 - "ckr" Checker
4 - Analex memory dump
5 - Title Program (for Fe or Fb types)
6 - Interlock Bits

<table>
<thead>
<tr>
<th>8</th>
<th>AD 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>AD 2</td>
</tr>
<tr>
<td>2</td>
<td>AD 3</td>
</tr>
<tr>
<td>3</td>
<td>AD 4</td>
</tr>
<tr>
<td>4</td>
<td>AD 5</td>
</tr>
<tr>
<td>5</td>
<td>AD 6</td>
</tr>
<tr>
<td>6</td>
<td>AD 7</td>
</tr>
<tr>
<td>7</td>
<td>AD 8</td>
</tr>
<tr>
<td>8</td>
<td>AD 9</td>
</tr>
<tr>
<td>9</td>
<td>AD 10</td>
</tr>
</tbody>
</table>
MEMO LW-9

MNEMONIC CODES

ad  Auxiliary Drum: Group Number
all  All: Drum Groups
bd  Buffer Drum: Group Number
bin  Binary: Tape Read Error
bri  Binary Read-In: Without fb-Title
ckr  Checker: A Drum Utility Program
cnv  Conversion Program: A Drum Utility Program
cri  Card Read-In: Binary Cards
did  Did: Execution of "erd" or "dtd"
dmp  Dump: DG #11 Memory Dump
dtd  Drum-to-Drum: Block Transfer
dri  Direct Read-In: Special Binary Read-In to Core
dup  Drum Utility Program: Selected
erd  Erase Drums
err  Error: UCP Halt
ers  Erase: Core Image before Read-In
exam  Examine: Contents of Specified DA
fld  Field: Illegal Core Field Selection
flx  Flexo: Illegal Character
gpm  Generalized Post-Mortem: A Drum Utility Program
grp  Group: Illegal Drum Group Selection
ign  Ignore: Areas Addressed to Locked Groups, Not Read-In
ins  Insert: Contents of Specified DA
lck  Lock: Add to, or Subtract from, Interlock
lkt  Locked: Drum Group Addressed by Read-In is Locked
lmr  LMR: Contents or Illegal Selection
log  Log: Time and Date on Selected Printer
mcm  Magnetic Core Memory: Core Fields in A and B Positions
mtp  Magnetic Tape Program: Utility Program must be Obtained from Magnetic Tape
mts  Magnetic Tape Search: Trouble
nlg  No Log: Suppress Logging
nop  No Operation: Clear Activate Bits and Switch Fields
pbt  Punch Binary Tape: If an fc-Tape is Read In
ppp  Program Print Program: A Drum Utility Program
rmr  RMR: Contents or Illegal Selection
rmt  Read Magnetic Tape: Start with Selected Record Number
rup  Read Utility Program: From Magnetic-Tape to Drum
set  Set Time and Date: A Magnetic Tape Utility Program
sft  Suppress Flad Table: If fc-Tape is Read In
sta  Start-At: Selected Address
stb  Store on BD: If fp-Tape is Read In
sup  Sum Utility Program: Form New Check-Sum and Store
wst  Write Stop: On MT #3 for Delayed Output
**ERROR CODES**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>bin</td>
<td>Binary: Tape Read Error</td>
</tr>
<tr>
<td>err</td>
<td>Error: UCP Halt</td>
</tr>
<tr>
<td>fld</td>
<td>Field: Illegal Core Field Selection</td>
</tr>
<tr>
<td>flx</td>
<td>Flex: Illegal Character</td>
</tr>
<tr>
<td>grp</td>
<td>Group: Illegal Drum Group Selection</td>
</tr>
<tr>
<td>lmr</td>
<td>LMIR: Illegal Selection</td>
</tr>
<tr>
<td>mts</td>
<td>Magnetic Tape Search: Trouble</td>
</tr>
<tr>
<td>rnr</td>
<td>RMIR: Illegal Selection</td>
</tr>
</tbody>
</table>
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Memo LW-9

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<td>0.00000</td>
<td>0.00001</td>
<td>1.00000</td>
<td>0.00000</td>
<td>0.00000</td>
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