



DATA PROCESSING

8 PELHAM ROAD
NATICK, MASSACHUSETTS

THE NEW WHIRLWIND UTILITY CONTROL PROGRAM

- A Revision of the Drum Group II Program -

Richard K. Bennett

DATA PROCESSING

Memo LW-9

8 PELHAM ROAD
NATICK, MASSACHUSETTS

January 20, 1959

THE NEW WHIRLWIND UTILITY CONTROL PROGRAM

Not Installed

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.

TABLE OF CONTENTS

Page No.

A. ESSENTIALS

1.	<u>"Examine" Button</u>	4
2.	<u>Flip-Flops</u>	4
3.	<u>Toggle Switches</u>	4
4.	<u>ck - Order Switch</u>	5
5.	<u>Magnetic Tape Read-In</u>	5
6.	<u>Interlock</u>	5
7.	<u>Log Suppression</u>	6
8.	<u>CS II STOP</u>	6
9.	<u>Director Tapes</u>	6
10.	<u>Scope Post-Mortem</u>	6
11.	<u>Scope Log</u>	6
12.	<u>Read-In</u>	6
13.	<u>Buffer-Drum Storage</u>	6
14.	<u>Stop on si 11 or 12</u>	7

B. FEATURES

1.	<u>Pattern</u>	8
2.	<u>Logging</u>	8
3.	<u>Error Behavior</u>	8
4.	<u>Program Entry to UCP</u>	8
5.	<u>Master Program</u>	9
6.	<u>Ignored Characters</u>	10
7.	<u>Control Words</u>	11
8.	<u>Interlock</u>	13
9.	<u>Room 222 Control</u>	13
10.	<u>Magnetic Tape Format</u>	13
11.	<u>Switch Fields</u>	14
12.	<u>Start-Over at 26</u>	14
13.	<u>Address Display</u>	14
14.	<u>Magnetic Tape Display</u>	15
15.	<u>Binary Input Display</u>	15
16.	<u>Erase</u>	15

C. CATEGORIES

<u>00</u>	<u>Read-In (Automatic)</u>	16
<u>01</u>	<u>Read-In, Special Action</u>	16
<u>02</u>	<u>Examine and Insert</u>	17
<u>03</u>	<u>Write Stop Character</u>	17
<u>04</u>	<u>Erase Drums</u>	18
<u>05</u>	<u>PAPM</u>	18
<u>06</u>	<u>Memory Dump</u>	18

DATA PROCESSING

Memo LW-9

Page 3.

Page No.

C. CATEGORIES (Continued)

<u>07 Start-At</u>	19
<u>12 Log Time and Date</u>	20
<u>13 No Log</u>	20
<u>16 Set Interlock</u>	20
<u>22 Checker</u>	21
<u>23 Binary Read-In</u>	22
<u>24 Card Read-In</u>	22
<u>25 Direct Read-In</u>	22
<u>30 Drum Checker</u>	22
<u>33 Execute fp-Tape</u>	23
<u>40 Magnetic Tape Checker</u>	23
<u>44 Drum to Drum Transfer</u>	23
<u>50 Scope Calibration</u>	23
<u>55 Program Print Program</u>	24
<u>60 PETR Check</u>	24
<u>62 Form Check-Sum for Drum Utility Program</u>	24
<u>63 Read-In Drum Utility Program</u>	24
<u>64 Read Program from Magnetic Tape</u>	25
<u>65 Magnetic Tape Copy</u>	25
<u>66 Magnetic Tape Record Formation</u>	25
<u>71 Test Storage Check</u>	25
<u>76 Set Time and Date</u>	25
<u>77 No Operation</u>	26

APPENDIX

<u>Utility System Categories</u>	27
<u>RMIR Configuration</u>	28
<u>LMIR - "A" Configuration</u>	28
<u>LMIR - "B" Configuration</u>	28
<u>LMIR - "C" Configuration</u>	29
<u>LMIR - "D" Configuration</u>	29
<u>LMIR - "E" Configuration</u>	29
<u>Octal Codes for LMIR Digits</u>	30
<u>Interlock Control - Digit 1</u>	30
<u>Magnetic Tape Unit - Digit 2</u>	31
<u>Number of Dependent Tapes - Digit 3</u>	31
<u>Input Device - Digit 4</u>	31
<u>Output Device - Digit 5</u>	32
<u>Drum Utility Program - Digit 5</u>	32
<u>Interlock Bits</u>	32
<u>Mnemonic Codes</u>	33
<u>Error Codes</u>	34
<u>Index</u>	35

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.

	<u>Octal</u>	<u>Entry</u>
7/0.50002	ta 2	7
8/0.34320	cf 320	10
9/0.77777	sp 3777	11

3. Toggle Switches (Cont.)

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

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.

~~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).~~

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.

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 si 1 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 splicing 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 3ab: 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 (octal) to mean BD). (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 <u>m</u> times.
0.56001 - 0.67077	Spare - Illegal
0.67100 - 0.67177	fb Title

7. Control Words (Continued)

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

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 B positions. The ck 40+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.~~

Memo LW-9

~~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 l 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.

P
o

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

01 ~~"pbt/stb"~~ 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"); ~~or if the input is an fp tape, the tape is stored on the Buffer Drum for later use ("stb").~~ The punch is delayed, unless the Direct Flexo is selected.

02 "exam-ins" 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 EI, 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 "wst" Write Stop Character

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

* If the si 1 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 LMIR. 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~~ ^{delayed} printer is performed.

~~Digit 2: Magnetic Tape Unit~~

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

66

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 LMIR, with the least significant octal digits 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*

DATA PROCESSING

Memo LW-9

Page 19.

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 S - ~~4~~³ Initial DA

Digit ~~5~~: ~~4, 5~~: ~~Output Unit (any)~~ *Core Fields*

07 "sta" Start-At

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

~~If~~ ^{The} Starting Address is given in the LMIR, ^{and} ~~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 0.40000 +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 1.10000

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 -n+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 ~~(by Category 01).~~

~~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 LMIR. On manual entry, a halt occurs, as for Category 04. Example

dtd ad 8 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~~

~~rup gpm~~

~~L-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 (o). ~~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~~

*Alex memory Dump
(See page 18)*

~~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

Buffer Drum

This program is read from ~~magnetic tape~~ directly to core memory (without disturbing core image on DG #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.~~

DATA PROCESSING

Memo LW-9

Page 27.

APPENDIX

UTILITY SYSTEM CATEGORIES

No.	Code	Title	LMIR
00	(Date)	Read-In	A
01	ppt	If fc Tape, Punch Binary Tape	A
	stb	If fp Tape, Store on Buffer Drum	A
02	exm	Examine	
	ins	Insert	
03	wst	Write stop Character	
04	erd	Erase Drums	D
05	gpn	PAPM	A
06	dmp	Memory Dump	C
07	sta	Start-at	E
		L-Modifier: Use starting address of last tape read in.	
12	log	Log Time and Date	A
		L-Modifier: Log all future information on the selected unit.	
13	nlg	No Log	
		L-Modifier: Suppress only area log.	
16	lck	Set Interlock	D
		L-Modifier: Release lock.	
22	ckr	Checker (See separate memo)	
23	bri	Binary Read-In	A
24	cri	Card Read-In	A
25	dri	Direct Read-In	
30	mtp	Drum Checker	
33	gpn	Execute fp -Tape	
40	mtp	Magnetic Tape Checker	
44	ddd	Drum to Drum Transfer <i>Scope PM</i>	D
50	mtp	Scope Calibration	
55	ppp	Program Print Program	A
60	mtp	PETR Check	
62	sup	Form Check-sum for Drum Utility Program	B
63	rup	Read-In Drum Utility Program	B
		L-Modifier: Read only if not in position on drums.	
64	rmt	Read Program from Magnetic Tape (Stop on si 1 after positioning tape)	B
		L-Modifier: Read only one record.	
65	mtp	Magnetic Tape Copy	
66	mtp	Magnetic Tape Record Formation <i>Analex memory Dump</i>	
71	mtp	Test Storage Check	
76	set	Set Time and Date	
77	nop	No Operation	

DATA PROCESSING

Memo LW-9

Page 28.

RMIR CONFIGURATION

S	1	2	3	4	5
	Generalized Post-Mortem Selection except 0, 1, which is the R-Modifier.	Core Field <i>A</i> magnetic Tape Unit	Core Field <i>B</i>		Category Number <i>a magnetic tape block No. (over III)</i>
		Switch Fields (00 = do not switch fields)			

LMIR - "A" CONFIGURATION

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

S	1	2	3	4	5	
L	Mod-ifier	Interlock Control	Magnetic Tape Unit	Number of Dependent Tapes	Input Unit	Output Unit

LMIR - "B" CONFIGURATION

For Categories: ~~62, 63~~, 64

S	1	2	3	4	5
L	Mod-ifier	Interlock Control	Magnetic Tape Unit	Tape Record Number or Drum Utility Program	

DATA PROCESSING

Memo LW-9

Page 29.

LMIR - "C" CONFIGURATION

For Category 06

S	1	2	3	4	5
DA (to even octal 10) for Dump				Core Field A	Output Unit Core Field E

LMIR - "D" CONFIGURATION

For Categories: 04, 16, 44

S	1	2	3	4	5
"From" Drum Group			"To" Drum Group "Erase" Drum Group "Lock" Drum Group		

LMIR - "E" CONFIGURATION

For Category 07

S	1	2	3	4	5
---	---	---	---	---	---

Core Memory Address

~~L~~
~~Mod~~
~~ifier~~

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 - PETR~~
- ~~1 - MTR~~
- ~~2 - Keyboard~~
- ~~3 - MTR, Pm. 222~~

Output Device - Digit 5

- 0 - Anelex
- 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 - *Anelex memory dump*

Interlock Bits ⁵ - *"DCP"*
⁶ - *Title Program (For fc or fb tapes)*

S	AD 1		10	BD 2
1	AD 2		11	BD 3
2	AD 3		12	BD 4
3	AD 4			
4	AD 5		13	BD 5
5	AD 6		14	BD 6
6	AD 7		15	BD 7
7	AD 8			
8	AD 9			
9	AD 10			

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
exm	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	LMIR: 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 fc-Tape is Read In
ppp	Program Print Program: A Drum Utility Program
rnr	RMIR: 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

~~bin Binary: Tape Read Error
err Error: UCP Halt
fld Field: Illegal Core Field Selection
flx Flexo: Illegal Character
grp Group: Illegal Drum Group Selection
lmr LMIR: Illegal Selection
mts Magnetic Tape Search: Trouble
rnr RMIR: Illegal Selection~~

INDEX

- Activate -
 - Bits, 8, 26
 - Buttons, 10
- Address Display, 14
- Area Log, 20
- Back Space, 10
- Binary, - 34
 - Cards, 22
 - Input Display, 15
 - Input Program, 11, 16
 - Special, 22
 - Tape without an fb Title, 22
 - Read-In, 22
- Blank Tape, 10
- Block, 13
- Buffer Drum, 23 -
 - Storage, 6
- ca n - Control Word, 12
- ca 0 - Control Word, 12, 22
- Card Read-In, 22
- Cards, 22
- Carriage Return, 10
- Categories, 16
- Category Number, 4
- Change Fields, 11
- Checker, 21
- Check Sum, 11, 12, 24
- ck 0 - Control Word, 11, 12
- ck 3ab - Control Word, 12, 22
- ck 400+d - Control Word, 12, 22
- ck order, 5
- Color, 10
- Control Words, 11, 22
- Conversion, 10, 31 -
 - Combined, 10, 31
 - Program, 9, 10, 16
- Core Fields, 14, 26
- Core Field Reset Switches, 14
- Core Image, 14, 22, 23, 24, 25
- CS II, 9
- DA - Control Word, 11
- Date, 20, 25
- Digit 1, 30
- Digit 2, 31
- Digit 3, 31
- Digit 4, 31
- Digit 5, 32
- Direct Read-In, 22
- Director Tapes, 6, 9
- Ditto, 22
- Ditto m-Control Word, 11, 12
- Drum -
 - Checker, 22
 - Group Override, 11
 - to-Drum, 23
 - Utility Programs, 16, 21, 24, 32
- Dump, 18
- End of Information, 22
- Erase, 15 -
 - Drums, 11, 18
- Error, 34 -
 - Behavior, 8
- "Examine", 13 -
 - Button, 4
- Execute fp tape, 23
- Executive Tape, 21
- fb -
 - Tape, 6, 10, 16, 30
 - Title, 11
- fc -
 - Tape, 6, 10, 16, 30, 31
 - Title, 10
- Field, 34
- Flexo, 34
- Flip-Flops, 4
- fp Tape, 6, 10, 16, 23
- Generalized Post-Mortem Program
 - 4, 6, 16, 23
- Group, 34

Ignored Characters, 10
Indicator Lights, 17
Input Device, 31
Interlock, 5, 13, 20 -
 Bits, 32
 Control, 13, 30
 Override, 30
 Reset, 30
 Set, 30

Left Activate -
 Bit, 8
 Button, 13, 15
LMIR, 9, 13, 16, 17, 28, 29,
 30, 34
L-Modifier, 16, 20, 28, 29
Log, 20
Logging, 8
Log Suppression, 6, 20
Lower Case, 10

Magnetic Tape, 5, 22, 23, 24, 25 -
 Checker, 23
 Copy, 25
 Display, 15
 Format, 13
 Record Information, 25
 Record Number, 12
 Search, 34
 Unit, 31
Manual Entry, 18, 23
Master Program, 6, 9, 10, 19
Memory Dump, 18
MIR's, 4, 8, 13

-n+1 - Control Word, 12
No Log, 20
No Operation, 26
Nullify, 10
Number of Dependent Tapes, 31

Output Device, 32
Override Interlock, 30

PAPM, 18
pattern, 8
PETR Check, 24

Program -
 Block, 11, 12, 22
 Entry, 8
 Parameters, 9
 Print, 24, 31

Read-In, 6, 16, 24
Record, 13 -
 Number, 14, 25
Reset Interlock, 30
Return Address, 10, 19
RI Button, 4, 13
Right Activate -
 Bit, 8
 Button, 4, 13, 18
RMIR, 4, 9, 13, 14, 16, 17, 28, 34
R-Modifier, 16, 28
Room 222, 13
RS Button, 10, 14, 17, 19, 31

Scope -
 Calibration, 23
 Log, 6
 Post-Mortem, 6
Set Interlock, 30
si 1, 31
si 11 or 12, 7
Slash, 10
sp 0 - Control Word, 22, 12
sp 1 - Control Word, 22, 12
sp 2 - Control Word, 22, 12
sp 31, 8
sp 32, 8
Space, 10
Special Binary Input Program, 22
Start-At -
 Category, 9, 19
 Zero, 9
Starting Address, 10, 19
Start-Over at 26, 14
Stop -
 Flexo Character, 10
 Write on delayed tape, 14
 UCP Request, 9, 10, 19
STOP, 6, 9
Stop on si 11 or 12, 7
Suppressed, 20

Suppression, Log, 5, 16
Switch Fields, 14

Tabulation, 10
Test Storage, 4 -
 Check, 25

Time, 20, 25
Title, 31
Toggle Switches, 4, 5

Upper Case, 10
Utility Program, 22, 23, 24, 25

Write Stop Character, 17

1010.3
FLIP FLOP STORAGE LINE UP

1618.8

0	0.00000	0.00001	1.00000	0.00000	0.00000	0.00000	0.00000	0.50002
10	0.34320	0.77777	1.00005	0.74002	1.00006	0.20040	0.74004	0.00102
20	1.00006	0.10040	0.74004	0.14062	0.40024	0.33741	1.00023	1.14024
30	0.74036	0.50003	1.00032	0.00707	0.20032	1.14025	0.00703	0.10036