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IDENTIFICATION

PRODUCT CODE: MAINDEC-11-DZTUE-D-D

PRODUCT NAME: TU16 UTILITY DRIVER

DATE CREATED: 21 APRIL 76

MAINTAINER: DIAGNOSTIC ENGINEERING

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:TABLE OF CONTENTS

(PAGE 1)

1. ABSTRACT

THIS PROGRAM IS INTENDED AS A BRUTE FORCE ROUTINE
TO EXECUTE AN OPERATION OR SERIES OF OPERATIONS, CONTINUOUSLY
REGARDLESS OF THE RESULTS OF THE OPERATION. BECAUSE
OF THE COMPLEXITY OF THE TU16 MAG TAPE SYSTEM AS
OPERATED ON THE MASSBUS, IT IS NOT ALWAYS POSSIBLE TO
PROVIDE FOR EVERY CONTINGENCY IN THE NORMAL PROGRAMS.
THEREFORE THIS UTILITY DRIVER WILL ALLOW AN OPERATOR
TO EXECUTE ANYTHING DESIRED IN ANY ORDER. THERE ARE
NO ERROR CHECKS OR PRINTOUTS MADE, AND ANY VARIATION
FROM PRESET SEQUENCES AND VALUES ARE MADE BY
CHANGING THE APPROPIATE MEMORY LOCATIONS.

2. REQUIREMENTS

2.1 HARDWARE:

A. ANY PDP-11 PROCESSOR - WITH OR WITHOUT HARDWARE SWITCH REGISTER.
B. RH MASSBUS CONTROLLER
C. TM02 MAG TAPE CONTROLLER
D. AT LEAST ONE (1) TU16 SLAVE

2.2 STORAGE:

THIS PROGRAM REQUIRES AT LEAST 3K OF CORE

3. LOADING PROCEDURE:

USE STANDARD BINARY LOADING PROCEDURE

4. STARTING PROCEDURE

THE PROGRAM IS ALWAYS STARTED AT LOCATION 200 (8)

***LOC. 176 (SWREG) IS DEFINED AS THE SOFTWARE SWITCH REGISTER
(REFER TO SECTION 5 FOR MORE DETAIL)

***IF THE SOFTWARE SWITCH REGISTER IS USED THE DIAGNOSTIC TYPES OUT THE FOLLOWIN
MESSAGE; SWR=XXXXXX NEW= (REFER TO SECTION 5 FOR OPERATOR OPTIONS)
AT THE START OF THE PROGRAM.

5. CONSOLE SWITCH SETTINGS

IF THE DIAGNOSTIC IS RUN ON A CPU WITHOUT A SWITCH REGISTER THEN A SOFTWARE SWITCH REGISTER IS USED WHICH ALLOWS THE USER THE SAME SWITCH OPTIONS AS THE HARDWARE SWITCH REGISTER. IF THE HARDWARE SWITCH REGISTER DOES NOT EXIST OR IF ONE DOES AND IT CONTAINS ALL ONES (177777) THEN THE SOFTWARE SWITCH REGISTER (LOC. 176) IS USED.

CONTROL:

THIS PROGRAM ALSO SUPPORTS THE DYNAMIC LOADING OF THE SOFTWARE SWITCH REGISTER (LOC. 176) FROM THE TTY. THIS CAN BE ACCOMPLISHED BY DOING THE FOLLOWING:

1) TYPE CONTROL G (^G); THIS WILL ALLOW THE TTY TO ENTER DATA INTO LOC. 176 AT SELECTED POINTS WITHIN THE PROGRAM.

2) THE MACHINE WILL THEN TYPE: SWR=XXXXXXNEW= (XXXXXX IS THE OCTAL CONTENTS OF THE SOFTWARE SWITCH REGISTER.)

3) AFTER THE ''NEW='' HAS BEEN TYPED THEN THE OPERATOR CAN DO ONE OF THE FOLLOWING AT THE TTY:

   A) TYPE A NUMBER TO BE LOADED INTO LOC. 176 FOLLOWED BY A (CR). (ONLY NUMBERS BETWEEN 0-7 WILL BE ACCEPTED AND ONLY 6 NUMBERS WILL BE ALLOWED)
   IF A (CR) IS THE FIRST KEY DEPRESSED THE SOFTWARE SWITCH REGISTER CONTENTS WILL NOT BE CHANGED.

   B) IF A CONTROL U (^U) IS DEPRESSED THEN THE PROGRAM WILL SEND YOU BACK TO STEP 2.

SW15(100000): 1=STOP AFTER EACH OPERATION
              0=PROCEED
SW14(040000): 1=STOP AT THE END OF THE OPERATION SEQUENCE
              0=PROCEED
SW13(020000): 1=IGNORE END OF TAPE (EOT)
              0=REWIND AT END OF TAPE (EOT)

5.1 HALT

***TO CHANGE THE CONTENTS OF SWREG TYPE (^G) BEFORE PRESSING CONTINUE AFTER A HA

(PAGE 2)

6. OPERATION

THE PROGRAM OPERATION IS QUITE SIMPLE, BUT DOES REQUIRE THE OPERATOR TO HAVE KNOWLEDGE OF THE TU16 TAPE SYSTEM AS OPERATED ON THE RH MASSBUS CONTROLLER. THE OPERATOR MUST BE ABLE TO DECIDE WHICH SEQUENCE OF OPERATION IS REQUIRED, AND WHAT VALUES TO ASSIGN TO THE VARIOUS PARAMETERS REQUIRED TO EXECUTE THEM. THE OPERATION SEQUENCE IS SET UP BY LOADING A TABLE WITH THE FUNCTION CODES OF THE DESIRED OPERATIONS AND SETTING THE NUMBER OF OPERATIONS IN A COUNTER. THE PROGRAM IS SET UP TO DO A WRITE OF TEN (8) WORDS OF ALL ONES DATA TO SLAVE ZERO (0) ON DRIVE ZERO (0) IN PE (1600 BPI) WITH A NINE TRACK NORMAL DATA FORMAT. THE DATA ADDRESS IS 3000 (8). THE OPERATION SEQUENCE IS SET TO DO A SINGLE WRITE. IF LOADED AND STARTED AT 200 (8) WITH NO CHANGES MADE AND SWITCH 14 AND 15 SET TO A ZERO (0), THIS OPERATION WILL BE EXECUTED CONTINUOUSLY.
THE FOLLOWING IS THE LIST OF PARAMETERS WHICH MAY BE VARIED AND A DESCRIPTION OF EACH ALONG WITH THEIR CORE LOACATION:

PARAMETER	LOCATION	DESCRIPTION
RH ADDRESS	600	ADDRESS OF RH (THE FIRST REGISTER ADDRESS: 25
DRIVE NUMBER	700	SET TO SELECT TM02 NUMBER ADDRESS 0-7
UNIT DESCRIPTION	702	SET SELECTED SLAVE NUMBER (0-7) IN BITS 0,1,2 SELECT PARITY IN BIT 3 (0=ODD 1=EVEN) SELECT DATA FORMAT IN BITS 4,5,6,7 SELECT DENSITY IN BITS 8,9,10
FRAME COUNT	704	SET NUMBER OF FRAMES TO WRITE PER WORD COUNT AND IN TWOS' COMPLIMENT
WORD COUNT	706	SET NUMBER OF WORDS TO BE TRANSFERRED IN TWOS' C
READ ADDRESS	710	SET DESIRED ADDRESS FOR START OF READ BUFFER.
WRITE ADDRESS	712	SET DESIRED ADDRESS FOR START OF WRITE BUFFER.
READY DELAY	714	THIS DELAY VALUE IS USED BY THE PROGRAM TO ESTAB A MAXIMUM TIME TO AWAIT THE COMPLETION OF AN OPE BEFORE PROCEEDING TO THE NEXT. **(DEFAULT IS APP
READY MULTIPLIER	716	IF THE VALUE SET INTO 714 DOES NOT ALLOW ENOUGH INCREASE THE SIZE OF THE MULTIPLIER. EACH INCRE MULTIPLIER WILL CAUSE THE 714 DELAY TO BE EXECUT THAT MANY MORE TIMES.

(PAGE 3)

OPERATION DELAY	720	THIS DELAY IS USED TO ALLOW FOR SOME AMOUNT OF TIME BETWEEN THE EXECUTION OF EACH OPERATION. I LOADED AND USED JUST AS IN THE READY DELAY(714, **(DEFAULT IS APPROX 54 MS FOR PDP-11/20)**
OPER MULTIPLIER	722	THIS IS USED JUST AS THE READY DELAY MULTIPLIER(
OPERATION NUMBER	724	THIS IS THE NUMBER OF OPERATIONS TO BE PERFORMED IN A SEQUENCE AND SHOULD REFLECT THE NUMBERS OF OPERATIONS SET INTO THE OPERATION TABLE.
OPERATION TABLE	740-770	THIS TABLE (CONSISTING OF 15 LOCATIONS) IS TO BE LOADED WITH THE FUNCTION CODES FOR EACH OPERATIO TO BE PERFORMED IN SEQUENCE. THE NUMBER OF ENTI MAY BE FROM ONE (1) TO FIFTEEN (15). MAKE SURE THE NUMBER OF FUNCTION CODES SET IN THE TABLE IS BY THE NUMBER IN LOCATION 724 (OPNUM)

6.1 FUNCTION CODES

20=READ IN PRESET
02=REWIND-OFF LINE
06=REWIND
10=DRIVE CLEAR
26=WRITE TAPE MARK
24=ERASE
30=SPACE FORWARD
32=SPACE REVERSE
50=WRITE CHECK FORWARD
56=WRITE CHECK REVERSE
60=WRITE FORWARD
70=READ FORWARD
76=READ REVERSE

(PAGE 4)

6.2 DATA FORMATS (BIT 7,6,5,4 OF UNIT DESCRIPTION)

14=NINE TRACK NORMAL: 2 FRAMES PER WORD
15=CORE DUMP: 4 FRAMES PER WORD

6.3 DENSITY (BITS 10,9,8 OF UNIT DESCRIPTION)

4=1600 BPI:PE (PE USES ONLY ODD PARITY)
3=800 BPI:NRZI
2=900 BPI:NRZI
1=556 BPI:NRZI
0=200 BPI:NRZI

6.4 PARITY (BIT 3 OF UNIT DESCRIPTION)

1=EVEN PARITY
0=ODD PARITY

6.5 SLAVE SELECT (BITS 2,1,0 OF UNIT DESCRIPTIONS)

SET TO DEVICE SLAVE ADDRESS (0-7)

(PAGE 5)

7. PROGRAM DESCRIPTION

IN ORDER TO MAINTAIN THE CONTINUOUS EXECUTION OF
THE OPERATIONS DESCRIBED THE PROGRAM IS ORGANIZED AS
FOLLOWS:

START
INITIALIZE THE RH
SET UP TAPE PARAMETERS (DENSITY, PARITY, FORMAT: WORD COUNT, FRAME COUNT, BUS AD
SELECT DEVICE TO TEST (DRIVE NUMBER, SLAVE NUMBER)
EXECUTE OPERATION (SET FUNCTION AND FROM OP TABLE AND SET GO=1)
AWAIT END OF OPERATION (READY DELAY)
STOP IF SWITCH 15=1
DO OPERATION DELAY (OP DELAY)
STOP IF LAST OPERATION IN SEQUENCE AND SWITCH 14=1
POINT TO NEXT FUNCTION CODE IN OP TABLE
JUMP BACK TO START

7.1 FLOW:

START:	HOUSEKEEPING
INIT:	CLEAR MASSBUS AND TM02
SET UP:	SET UP REQUIRED REGISTERS
EXECUTE:	SET FUNCTION AND GO=1
AWAIT END:	LOOP ON DRY=1 AS LONG AS ALLOWED BY READY DELAY
STOP:	IF SWITCH 15=1
DELAY:	PER OP DELAY
END OF RSEQUENCE?	IF NOT JUMP TO START
STOP:	IF SWITCH 14=1
JUMP TO START	RESTART SEQUENCE

7.2 VARIATIONS: THERE ARE TWO VARIATIONS MADE FROM THIS FLOW.
BOTH ARE CAUSED BY A PARITCULAR FUNCTION CODE.
IF A READ REVERSE IS TO BE EXECUTED, THEN THE
BUS ADDRESS IS INCREMENTED BY THE SIZE OF THE
RECORD BECAUSE THE DATA IS LOADED INTO MEMORY
IN REVERSE (I.E: HIGH ADDRESS TO LOW ADDRESS)
THE SECOND VARIATION IS CAUSED BY A SPACE (FORWARD OR REVERSE)
OPERATION AND IT IS THAT THE FRAME COUNTER IS SET TO A -1
SO THAT ONLY ONE (1) RECORD IS SPACED OVER. IF YOU WISH
TO SPACE OVER MORE THAT ONE (1) RECORD, SET LOCATION 1100 (8)
TO THE TWOS' COMPLIMENT OF THE NUMBER OF RECORDS DESIRED.

8. LISTING

```
%
        .TITLE TU16 UTILITY DRIVER
        ;MAINDEC-11-DZTUE-D-D
        ;15 FEB 75
        ;R. BARNES
        ;REVISED APRIL ,1976 BY S. CARPENTER
        ;       1) SUPPORTS SOFTWARE SWITCH REGISTER
        ;       2) SUPPORTS THE DYNAMIC LOADING OF THE SOFTWARE SWITCH REGISTER
        .ABS
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                                        ;CONSOLE SWITCHES

                                        ;SW 15=1(100000) STOP ON EACH OPERATION
                                        ;                0 CONTINUE
                                        ;Sw 14=1(040000) STOP AT END OF SEQUENCE
                                        ;                0 CONTINUE
                                        ;SW 13=1(020000) IGNORE END OF TAPE (EOT)
                                        ;                0 REWIND AT END CF TAPE (EOT)

                                        ;REGISTER EQUIVES

            000000                      R0=%0
            000001                      R1=%1
            000002                      R2=%2
            000003                      R3=%3
            000004                      R4=%4
            000005                      R5=%5
            000006                      SP=%6
            000007                      PC=%7

            000046                      .=46
000046  000170                          RESTART:        170             ;ALLOW RESTART WHEN (LF) IS PRESSED
                                                                        ;DURING CHANGING OF SWREG IF SOFTWARE SWITCH
                                                                        ;REGISTER IS USED.


                                        ;SOFTWARE SWITCH REGISTER**********

            000176                      .=176
000176  000000                          SWREG:  0               ;SOFTWARE SWITCH REGISTER

                                        ;*************************************************************************

                                        ;THIS PROGRAM SUPPORTS THE SOFTWARE SWITCH REGISTER LOC.176.
                                        ;REFER TO SECTION 5 OF DOCUMENT FOR DESCRIPTION

                                        ;*************************************************************************

                                        ;STARTING ADDRESS

            000200                      .=200
000200  000167  001110                  JMP     SETUR
            000600                      .=600

                                        ;TM02 REGISTERS

000600  172440                  C1:     172440
000602  172442                  WC:     172442
000604  172444                  BA:     172444
000606  172446                  FC:     172446
000610  172450                  CS:     172450
000612  172452                  DS:     172452
000614  172454                  ER:     172454
000616  172456                  AS:     172456
```

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  390  000620  172460 .                CC:     172460
  391  000622  172462                  DB:     172462
  392  000624  172464                  MR:     172464
  393  000626  172466                  DT:     172466
  394  000630  172470                  SN:     172470
  395  000632  172472                  C2:     172472
  386
  387                                   ;PROCESSOR ADDRESSES
  389
  389  000634  177776                  PSW:    177776          ;PROCESSOR STATUS
  390  000636  177570                  SWR:    177570          ;SWITCH REGISTER
  391
  392                                   ;TTY REGISTERS
  393
  394  000640  177560                  TKS:    177560          ;TTY READER STATUS
  395  000642  177562                  TKB:    177562          ;TTY READ BUFFER
  396  000644  177564                  TPS:    177564          ;TTY PUNCH STATUS
  397  000646  177566                  TPB:    177566          ;TTY PUNCH BUFFER
```

```
                        000700                          .=700
                                                        ;SET PARAMETERS DESIRED FOR UNIT UNDER TEST******
                                                        
000700  000000          DRVN:   0       ;DRIVE NUMBER
000702  002300          UDES:   2300    ;SLAVE DESCRIPTION
000704  177760          FCNT:   -20     ;FRAME COUNT
000706  177770          WCNT:   -10     ;WORD COUNT
000710  004000          RADDR:  4000    ;READ ADDRESS
000712  005000          WADDR:  5000    ;WRITE ADDRESS
000714  100000          RDYDLY: 100000  ;READY DELAY
000716  000001          RDYDX:  1       ;READY DELAY MULTIPLIER
000720  010000          OPDLY:  10000   ;OPERATION DELAY
000722  000001          OPDX:   1       ;OPERATION DELAY MULTIPLIER
000724  000001          OPNUM:  1       ;NUMBER OF OPERATION (1 TO 15)
000726  000000          TIB:    0
000730  000000          TOB:    0
000732  000000          COUNT:  0
000734  000000          RDSW:   0
000736  000000          TEMPST: 0

                                                        ;OPERATION TABLE**********
                                                        ;ENTER OPERATION SEQUENCE DESIRED.
                                                        ;MUST HAVE AT LEAST 1 OPERATION, AND
                                                        ;MAY HAVE UP TO 15(8).
                                                        ;SET THE OPERATION COUNTER EQUAL
                                                        ;TO THE NUMBER OF OPERATIONS IN
                                                        ;THE SEQUENCE.
                                                        ;
                                                        ;20 = READ IN PRESET
                                                        ;02 = REWIND-OFFLINE
                                                        ;06 = REWIND
                                                        ;10 = DRIVE CLEAR
                                                        ;26 = WRITE TAPE MARK
                                                        ;24 = ERASE
                                                        ;30 = SPACE FORWARD
                                                        ;32 = SPACE REVERSE
                                                        ;50 = WRITE CHECK FORWARD
                                                        ;56 = WRITE CHECK REVERSE
                                                        ;60 = WRITE FORWARD
                                                        ;70 = READ FORWARD
                                                        ;76 = READ REVERSE

000740  000060          OPTBL:  60
000742  000000                  0
000744  000000                  0
000746  000000                  0
000750  000000                  0
000752  000000                  0       ;FILL WITH OPERATION SEQUENCE
000754  000000                  0
000756  000000                  0
000760  000000                  0
000762  000000                  0
000764  000000                  0
000766  000000                  0
000770  000000                  0
```

```
   454
```

```
  455            001000                              .=1000
  456                                                ;START OF PROGRAM**********
  457
  458  001000    012706  000500          START:      MOV     #500,SP
  459  001004    012777  000340  177622              MOV     #340,@PSW
  460
  461  001012    016700  177706                      MOV     OPNUM,R0        ;SET COUNTER
  462  001016    012701  000740                      MOV     #OPTBL,R1       ;SET POINTER
  463  001022    012777  000040  177560  A:          MOV     #40,@CS         ;INIT
  464  001030    016777  177644  177552              MOV     DRVN,@CS        ;DRIVE NUMBER
  465  001036    016777  177640  177566              MOV     UDES,@C2        ;UNIT DESCRIPTION
  466  001044    016777  177636  177530              MOV     WCNT,@WC        ;WORD COUNT
  467  001052    016777  177626  177526              MOV     FCNT,@FC        ;FRAME COUNT
  468  001060    012102                              MOV     (R1)+,R2        ;SET OP CODE
  469  001062    022702  000030                      CMP     #30,R2          ;SEE IF SPACE FORWARD
  470  001066    001403                              BEQ     AA              ;IF SO: BR
  471  001070    022702  000032                      CMP     #32,R2          ;SEE IF SPACE REVERSE
  472  001074    001003                              BNE     A0              ;IF NOT: BR
  473  001076    012777  177777  177502  AA:         MOV     #-1,@FC         ;SET TO SPACE ONE RECORD
  474  001104    022702  000060          A0:         CMP     #60,R2          ;SEE IF READ OP
  475  001110    103404                              BLO     A1              ;IF SO: BR
  476  001112    016777  177574  177464              MOV     WADDR,@BA       ;SET WRITE ADDRESS
  477  001120    000413                              BR      A3
  478  001122    016777  177562  177454  A1:         MOV     RADDR,@BA       ;SET READ ADDRESS
  479  001130    022702  000070                      CMP     #70,R2          ;SEE IF READ OPERATION
  480  001134    001405                              BEQ     A3              ;IF SO: BR
  481  001136    016703  177542                      MOV     FCNT,R3         ;GET FRAME COUNT
  482  001142    005403                              NEG     R3
  483  001144    060377  177434                      ADD     R3,@BA          ;SET BUS ADDRESS FOR READ REVERSE
  484  001150    052702  000001          A3:         BIS     #1,R2           ;SET GO BIT
  485  001154    000240                              NOP
  486  001156    000240                              NOP
  487  001160    010277  177414                      MOV     R2,@C1          ;START OPERATION
  488  001164    000240                              NOP
  489  001166    000240                              NOP
  490  001170    016704  177522                      MOV     RDYDX,R4        ;SET DELAY MULTIPLIER
  491  001174    016703  177514          B0:         MOV     RDYDLY,R3       ;SET READY DELAY
  492  001200    032777  000200  177404  B:          BIT     #200,@DS
  493  001206    001005                              BNE     C               ;IF DRY: BR
  494  001210    005303                              DEC     R3
  495  001212    001372                              BNE     B
  496  001214    005304                              DEC     R4
  497  001216    001366                              BNE     B0              ;DELAY FOR DRIVE READY
  498  001220    000240                              NOP
  499  001222    005777  177410          C:          TST     @SWR            ;SEE IF STOP ON OPERATION
  500  001226    100001                              BPL     D               ;IF NOT: BR
  501  001230    000000                              HALT
  502  001232    004767  000302          D:          JSR     PC,CKSWR        ;CHECK FOR CNTL G
  503  001236    000240                              NOP
  504  001240    000240                              NOP
  505  001242    016704  177454                      MOV     OPDX,R4         ;SET DELAY MULTIPLIER
  506  001246    016703  177446          E0:         MOV     OPDLY,R3        ;SET OPERATION DELAY
  507  001252    005303                  E:          DEC     R3
  508  001254    001376                              BNE     E
  509  001256    005304                              DEC     R4
  510  001260    001372                              BNE     E0              ;DELAY BETWEEN OPERATIONS
```

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                                                ;GO SEE IF REWIND
                                                ;IF SEQUENCE NOT DONE: BR

                                                ;SEE IF HALT ON SEQUENCE
                                                HALT
                                                ;CHECK FOR CNTL G

                                                ;RH REGISTER SETUP**********

                                                ;GET ADDRESS OF CS1
                                                ;SET NUMBER OF REGISTERS
                                                ;GET FIRST ADDRESS
                                                ;INCREMENT
                                                ;LOAD ADDRESS
                                                ;SEE IF DONE
                                                ;IF NOT: BR
                                                        ;SAVE VECTORS

                                                ;SET UP FOR TIMEOUT
                                                ;REFERENCE HARDWARE SWITCH REGISTER

                                                ;ADJUST STACK
                                                ;POINT TO SOFTWARE SWITCH REG
                                                ;RESTORE VECTORS

                                                ;IS SOFTWARE REG USED
                                                ;BRANCH IF NC
                                                ;ALLOW SOFTARE SWITCH REGISTER TO BE CHANGED
                                                ;ELSE GO START EXECUTION

                                                ;REWIND FROM EOT (PER SW13)

                                                ;SEE IF IGNORE EOT
                                                ;IF SO: BR
                                                ;SEE IF AT EOT
                                                ;IF NOT: BR
                                                ;INIT
                                                ;SET DRIVE NUMBER
                                                ;SET SLAVE NUMBER
                                                ;START REWIND
                                                ;SEE IF DRY
                                                ;IF NOT: BR
                                                ;SEE IF PIP RESET
                                                ;IF NOT: BR
                                                ;RESET STACK
                                                ;RESTART SEQUENCE
                                                ;RETURN

                                                ;CKSWR ROUTINE THAT ALLOWS THE LOADING OF LOC.176, SWREG**********
                                                ;FROM THE TTY AT SELECTED POINTS WITHIN THE PROGRAM**********
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```
                                                                                
                                                                                
001540  022767  000001  177070  CKSWR:  CMP     #SWREG,SWR              ;SOFTWARE SWITCH REG PRESENT
001546  001041                          BNE     OUT                     ;NO, GET OUT
001550  105777  177064                  TSTB    @TKS                    ;YES,WAIT FOR
001554  100036                          BPL     OUT                     ;READY, GET CHARACTER
001556  017767  177060  177142          MOV     @TKB,TIB                ;AND STRIP OFF
001564  042767  177600  177134          BIC     #177600,TIB             ;THE GARBAGE
001572  022767  000007  177126          CMP     #7,TIB          ;IS IT A ^G
001600  001024                          BNE     OUT
001602  012704  002512                  MOV     #$CNTG,R4
001606  004767  000242                  JSR     PC,TTOUT
001612  012704  002516          CNTLU:  MOV     #$MSWR,R4
001616  004767  000232                  JSR     PC,TTOUT
001622  017703  177010                  MOV     @SWR,R3
001626  004767  000354                  JSR     PC,OCTPE
001632  012704  002525                  MOV     #$MNEW,R4
001636  004767  000212                  JSR     PC,TTOUT
001642  005037  000736                  CLR     @#TEMPST
001646  004767  000002                  JSR     PC,$READ                ;GO READ A LINE
001652  000207                  OUT:    RTS     PC                      ;RETURN TO MAIN BODY OF PROGRAM
                                                                                
001654  005067  177056          $READ:  CLR     TEMPST
001660  012767  000007  177044          MOV     #7,COUNT
001666  004767  000546          1$:     JSR     PC,TTIN         ;GO  READ A CHARACTER
001672  042767  177600  177026          BIC     #177600,TIB     ;STRIP OFF GARBAGE
001700  122767  000025  177020          CMPB    #25,TIB         ;IS IT A ^U?
001706  001002                          BNE     2$              ;BRANCH IF NOT
001710  005726                  3$:     TST     (SP)+           ;POP THE STACK
001712  000737                          BR CNTLU                ;START OVER
001714  122767  000015  177004  2$:     CMPB    #15,TIB         ;IS IT A <CR>?
001722  001013                          BNE     4$              ;BRANCH IF NOT
001724  012767  000200  177002          MOV     #200,RDSW
001732  004767  000150                  JSR     PC,TCRLF        ;ECHO IT WITH <LF>
001736  022767  000007  176766          CMP     #7,COUNT        ;WAS IT FIRST CHARACTER
001744  001037                          BNE     7$              ;CHANGE SWR IF NOT FIRST ONE
001746  005726                  8$:     TST     (SP)+           ;POP THE STACK
001750  000740                          BR      OUT             ;GET OUT
001752  122767  000060  176746  4$:     CMPB    #60,TIB
001760  003004                          BGT     5$
001762  122767  000067  176736          CMPB    #67,TIB
001770  003005                          BGT     6$
001772  012704  002535          5$:     MOV     #$QUEST,R4
001776  004767  000052                  JSR     PC,TTOUT
002002  000742                          BR      3$              ;START OVER IF NOT LEGAL CHARACTER
002004  006367  176726          6$:     ASL     TEMPST
002010  006367  176722                  ASL     TEMPST
002014  006367  176716                  ASL     TEMPST
002020  142767  000060  176700          BICB    #60,TIB         ;GET NITTY-GRITTY
002026  156767  176674  176702          BISB    TIB,TEMPST
002034  005367  176672                  DEC     COUNT           ;ONLY WANT 6   DIGITS
002040  001754                          BEQ     5$
002042  000711                          BR      1$
002044  016777  176666  176664  7$:     MOV     TEMPST,@SWR     ;CHANGE SWITCH REGISTER CONTENTS
002052  000735                          BR      8$
                                                                                
                                                                                
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```
                                        ;TTY OUTPUT SUBROUTINE***********

002054  112467  176650          TTOUT:  MOVB    (R4)+,TOB
002060  122767  000043  176642          CMPB    #43,TOB
002066  001446                          BEQ     TEX
002070  122767  000045  176632          CMPB    #45,TOB
002076  001403                          BEQ     TCRLF
002100  004767  000064                  JSR     PC,TOG
002104  000763                          BR      TTOUT
002106  112767  000015  176614  TCRLF:  MOVB    #15,TOB
002114  004767  000050                  JSR     PC,TOG
002120  012703  000004                  MOV     #4,R3
002124  005067  176600          TCRLFA: CLR     TOB
002130  004767  000034                  JSR     PC,TOG
002134  005303                          DEC     R3
002136  001372                          BNE     TCRLFA          ;DO FILLERS
002140  112767  000012  176562          MOVB    #12,TOB
002146  004767  000016                  JSR     PC,TOG
002152  105767  176556                  TSTB    RDSW
002156  100401                          BMI     1$
002160  000735                          BR      TTOUT
002162  005067  176546          1$:     CLR     RDSW
002166  000406                          BR      TEX
002170  105777  176450          TOG:    TSTB    @TPS
002174  100375                          BPL     TOG
002176  116777  176526  176442          MOVB    TOB,@TPB
002204  000207                  TEX:    RTS     PC

                                        ;OCTAL OUTPUT SUBROUTINE*********

002206  012767  000001  000222  OCTPE:  MOV     #1,OFL
002214  010304                          MOV     R3,R4
002216  000410                          BR      OCTPO
002220  005067  000212          OCTP:   CLR     OFL             ;CLEAR FLAG FOR LEADING ZERO
002224  010304                  OCTPE1: MOV     R3,R4           ;SEE IF NUMBER IS ZERO
002226  001004                          BNE     OCTPO           ;IF NOT ZERO: BR
002230  004767  000162                  JSR     PC,OCTPG1       ;ELSE PRINT ZERO
002234  000167  000120                  JMP     OCTP3           ;SPACE AND EXIT
002240  032704  100000          OCTPO:  BIT     #100000,R4      ;SEE IF MSD = 1
002244  001406                          BEQ     OCTP1           ;IF NOT: BR
002246  012704  000001                  MOV     #1,R4
002252  004767  000116                  JSR     PC,OCTPG        ;PRINT 1
002256  000167  000006                  JMP     OCTP2
002262  005004                  OCTP1:  CLR     R4
002264  004767  000104                  JSR     PC,OCTPG        ;PRINT 0
002270  010304                  OCTP2:  MOV     R3,R4
002272  006004                          ROR     R4
002274  006004                          ROR     R4
002276  006004                          ROR     R4              ;POSITION DIGIT
002300  006004                          ROR     R4
002302  000304                          SWAB    R4
002304  004767  000064                  JSR     PC,OCTPG        ;PRINT DIGIT 2
002310  010304                          MOV     R3,R4
002312  006004                          ROR     R4
002314  000304                          SWAB    R4
002316  004767  000052                  JSR     PC,OCTPG        ;PRINT DIGIT 3
```

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TU16 UTILITY DRIVER     MACY11 27(1006)  16-SEP-76  18:13  PAGE 18
OCTUED.P11    16-SEP-76 15:24

                                                MOV     R3,R4
                                                ROL     R4
                                                ROL     R4
                                                SWAB    R4
                        000036                  JSR     PC,OCTPG        ;PRINT DIGIT 4
                                                MOV     R3,R4
                                                ROR     R4
                                                ROR     R4
                                                ROR     R4
                        000022                  JSR     PC,OCTPG
                                                MOV     R3,R4
                        000014                  JSR     PC,OCTPG        ;PRINT DIGIT 5
                        000240  176342  OCTP3:  MOV     #240,TOB
                        177576                  JSR     PC,TOG          ;PRINT SPACE
                                                RTS     PC              ;EXIT
                        177770          OCTPG:  BIC     #177770,R4
                                                BNE     OCTPGO
                        000030                  TST     OFL
                                                BNE     OCTPGO
                                                RTS     PC
                        000020          OCTPGO: INC     OFL
                        000260          OCTPG1: BIS     #260,R4
                        176302                  MOV     R4,TOB
                        177536                  JSR     PC,TOG
                                                MOV     R3,R4
                                                RTS     PC
                                        OFL:    0                       ;FIRST CHAR FLAG

                                                ;TTY READ SUBROUTINE**********

                        176174          TTIN:   CLR     @TKS
                        176172                  CLR     @TKB
                        176252                  CLR     TIB
                        176160                  INC     @TKS
                        176154          TTIN1:  TSTB    @TKS
                                                BPL     TTIN1
                        176150  176232          MOV     @TKB,TIB
                        176144          TTIN2:  TSTB    @TPS
                                                BPL     TTIN2
                        176220  176136          MOVB    TIB,@TPB
                                                RTS     PC

                        021507          $CNTG:  .ASCII  /%1G#/
                        051127  020075  $MSWR:  .ASCII  /%SWR= #/
                            043
                        047040  053505  $MNEW:  .ASCII  /  NEW= #/
                        020075      043
                        021445          $QUEST: .ASCII  /?%#/
                    004000                      .=4000
                    000100                      .REPT   100
                                                0
                                                .ENDR

                    005000                      .=5000
                    000100                      .REPT   100
                                                177777
```

```
                                        .ENDR
                                        .END
```

CROSS REFERENCE TABLE -- USER SYMBOLS

```
T16 UTILITY DRIVER  MACY11 27.1006)  16-SEP-76  18:13  PAGE 22
DZTUED.P11  16-SEP-76 15:24          CROSS REFERENCE TABLE -- USER SYMBOLS

SETUP   001314          367     523#
SN      000630          384#
START   001000          458#    519     545     562
SUSWR   001350          532#
SWR     000636          390#    499     515     535     539*    542     549     568     580     619*
SWREG   000176          354#    539     542     568
TCRLF   002106          599     629     632#
TCRLFA  002124          635#    638
TEMPST  000736          416#    584*    588*    611*    612*    613*    615*    619
TEX     002204          627     645     649#
TI8     000726          412#    572*    573*    574     591*    592     596     604     606     614*    618     711*    715*
                        718
TKB     000642          395#    572     710*    715
TKS     000640          394#    570     709*    712*    713
TOB     000730          413#    625*    626     628     632*    635*    639*    648     691*    701*
TOS     002170          630     633     636     640     646#    647     692     702
TPB     000646          397#    648*    718*
TPS     000644          396#    646     716
TTIN    002440          590     709#
TTIN1   002460          713#    714
TTIN2   002474          716#    717
TTOUT   002054          577     579     583     609     625#    631     643
UDES    000702          402#    465     555
WADDR   000712          406#    476
WC      000602          373#    466*    526
WCNT    000706          404#    466
$CNTG   002512          576     721#
$MNEW   002526          582     724#
$MSWR   002516          578     722#
$QUEST  002536          608     726#
$READ   001654          585     588#
.     = 005200          345#    353#    366#    368#    398#    455#    727#    732#

. ABS.  005200     000

 ERRORS DETECTED:  0
 DEFAULT GLOBALS GENERATED:  0

 DZTUED,DZTUED.SEQ/SOL/CRF/DS:ERFZ/EN:ABS=DSkM:DZTUED.P11
 RUN-TIME: 2 4..4 SECONDS
 RUN-TIME RATIO: 22/7=2.8
 CORE USED:  6K  (11 PAGES)
```