

.NLIST SEQ,LOC,BIN
.REM_

IDENTIFICATION

PRODUCT CODE: AC-E481A-MC
PRODUCT NAME: CZTUMA0 TM02/TU45 UTILITY DRIVER
DATE CREATED: 25 MAY 1978
MAINTAINER: COMPUTER SPECIAL SYSTEMS
AUTHOR: R. B. BARNES/R. J. COLLINS

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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 TU45 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 APPROPRIATE MEMORY LOCATIONS.

2. REQUIREMENTS

2.1 HARDWARE:

- A. ANY PDP-11 PROCESSOR
- B. RH MASSBUS CONTROLLER
- C. TMO2 MAG TAPE CONTROLLER
- D. AT LEAST ONE (1) TU45 SLAVE

2.2 STORAGE:

THIS PROGRAM REQUIRES AT LEAST 1K OF CORE

3. LOADING PROCEDURE:

USE STANDARD BINARY LOADING PROCEDURE

4. STARTING PROCEDURE

THE PROGRAM IS ALWAYS STARTED AT LOCATION 200 (8)

5. CONSOLE SWITCH SETTINGS

IF A CONSOLE SWITCH REGISTER IS NOT PRESENT, THE FOLLOWING PROCEDURE MUST BE IMPLEMENTED:

- A) LOAD ADDRESS 636(8) LABELLED "SWR"
- B) DEPOSIT THE VALUE 176(8)
- C) LOAD ADDRESS 176(8)
- D) DEPOSIT THE DESIRED SWITCH VALUE.

SW15: 1=STOP AFTER EACH OPERATION
0=PROCEED

SW14: 1=STOP AT THE END OF THE OPERATION SEQUENCE
0=PROCEED

SW13: 1=IGNORE END OF TAPE (EOT)

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SEQ 0004

0=REWIND AT END OF TAPE (EOT)

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6. OPERATION

THE PROGRAM OPERATION IS QUITE SIMPLE, BUT DOES REQUIRE THE OPERATOR TO HAVE KNOWLEDGE OF THE TU45 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 LOCATION:

PARAMETER	LOCATION	DESCRIPTION
RH ADDRESS	600	ADDRESS OF RH (THE FIRST REGISTER ADDRESS: CS1)
DRIVE NUMBER	700	SET TO SELECT TMO2 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 FORMAT IN TWOS' COMPLIMENT
WORD COUNT	706	SET NUMBER OF WORDS TO BE TRANSFERRED IN TWOS' COMPLIMENT
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 ESTABLISH A MAXIMUM TIME TO AWAIT THE COMPLETION OF AN OPERATION BEFORE PROCEEDING TO THE NEXT. **(DEFAULT IS APPROX 435 MS FOR PDP-11/20)**
READY MULTIPLIER	716	IF THE VALUE SET INTO 714 DOES NOT ALLOW ENOUGH TIME, INCREASE THE SIZE OF THE MULTIPLIER. EACH INCREMENT OF THE MULTIPLIER WILL CAUSE THE 714 DELAY TO BE EXECUTED THAT MANY MORE TIMES.

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OPERATION DELAY	720	THIS DELAY IS USED TO ALLOW FOR SOME AMOUNT OF TIME BETWEEN THE EXECUTION OF EACH OPERATION. IT IS 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(716)
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	726-756	THIS TABLE (CONSISTING OF 15 LOCATIONS) IS TO BE LOADED WITH THE FUNCTION CODES FOR EACH OPERATION TO BE PERFORMED IN SEQUENCE. THE NUMBER OF ENTIRES MAY BE FROM ONE (1) TO FIFTEEN (15). MAKE SURE THAT THE NUMBER OF FUNCTION CODES SET IN THE TABLE IS REFLECTED 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

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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=800 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)

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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 ADDRESS)
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 TMO2
 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 PARTICULAR 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 THAN ONE (1) RECORD, SET LOCATION 1100 (8)
TO THE TWO'S COMPLEMENT OF THE NUMBER OF RECORDS DESIRED.

8. LISTING

```

288          .LIST  SEQ,LOC,BIN
289          .TITLE TU45 UTILITY DRIVER
290          :CZTUMAO
291          :25 MAY 1978
292          :R. BARNES/R. J. COLLINS
293
294          .ENABL  ABS
295
296          ;CONSOLE SWITCHES
297
298          ;SW 15=1 STOP ON EACH OPERATION
299          :      0 CONTINUE
300          ;SW 14=1 STOP AT END OF SEQUENCE
301          :      0 CONTINUE
302          ;SW 13=1 IGNORE END OF TAPE (EOT)
303          :      0 REWIND AT END OF TAPE (EOT)
304
305          ;REGISTER EQUIVES
306
307          000000      R0=X0
308          000001      R1=X1
309          000002      R2=X2
310          000003      R3=X3
311          000004      R4=X4
312          000005      R5=X5
313          000006      SP=X6
314          000007      PC=X7
315
316          ;STARTING ADDRESS
317
318          000200      .=200
319          000200 000167 001100      JMP      SETUP
320          000600      .=600
321
322          ;TM02 REGISTERS
323
324          000600 172440      C1:      172440
325          000602 172442      WC:      172442
326          000604 172444      BA:      172444
327          000606 172446      FC:      172446
328          000610 172450      CS:      172450
329          000612 172452      DS:      172452
330          000614 172454      ER:      172454
331          000616 172456      AS:      172456
332          000620 172460      CC:      172460
333          000622 172462      DB:      172462
334          000624 172464      MR:      172464
335          000626 172466      DT:      172466
336          000630 172470      SN:      172470
337          000632 172472      C2:      172472
338
339          ;PROCESSOR ADDRESSES
340
341          000634 177776      PSW:      177776      ;PROCESSOR STATUS
342          000636 177570      SWR:      177570      ;SWITCH REGISTER
343
    
```

344 000700

. = 700
; SET PARAMETERS DESIRED FOR UNIT UNDER TEST*****

345

346

347 000700 000000

DRVN: 0 ; DRIVE NUMBER

348 000702 002300

UDES: 2300 ; SLAVE DESCRIPTION

349 000704 177760

FCNT: -20 ; FRAME COUNT

350 000706 177770

WCNT: -10 ; WORD COUNT

351 000710 002000

RADDR: 2000 ; READ ADDRESS

352 000712 003000

WADDR: 3000 ; WRITE ADDRESS

353 000714 100000

RDYDLY: 100000 ; READY DELAY

354 000716 000001

RDYDX: 1 ; READY DELAY MULTIPLIER

355 000720 010000

OPDLY: 10000 ; OPERATION DELAY

356 000722 000001

OPDX: 1 ; OPERATION DELAY MULTIPLIER

357 000724 000001

OPNUM: 1 ; NUMBER OF OPERATION (1 TO 15)

358

; OPERATION TABLE*****

359

; ENTER OPERATION SEQUENCE DESIRED.

360

; MUST HAVE AT LEAST 1 OPERATION, AND

361

; MAY HAVE UP TO 15(8).

362

; SET THE OPERATION COUNTER EQUAL

363

; TO THE NUMBER OF OPERATIONS IN

364

; THE SEQUENCE.

365

366

; .

367

; 20 = READ IN PRESET

368

; 02 = REWIND-OFFLINE

369

; 06 = REWIND

370

; 10 = DRIVE CLEAR

371

; 26 = WRITE TAPE MARK

372

; 24 = ERASE

373

; 30 = SPACE FORWARD

374

; 32 = SPACE REVERSE

375

; 50 = WRITE CHECK FORWARD

376

; 56 = WRITE CHECK REVERSE

377

; 60 = WRITE FORWARD

378

; 70 = READ FORWARD

379

; 76 = READ REVERSE

380

381 000726 000060

OPTBL: 60

382 000730 000000

0

383 000732 000000

0

384 000734 000000

0

385 000736 000000

0

386 000740 000000

0

387 000742 000000

0

; FILL WITH OPERATION SEQUENCE

388 000744 000000

0

389 000746 000000

0

390 000750 000000

0

391 000752 000000

0

392 000754 000000

0

393 000756 000000

0

394

395

```

396      001000      . =1000
397      ; START OF PROGRAM*****
398
399 001000 012706 000500 START: MOV #500,SP
400 001004 012777 000340 177622 MOV #340,@PSW
401 001012 016700 177706 MOV OPNUM,R0 ;SET COUNTER
402 001016 012701 000726 MOV #OPTBL,R1 ;SET POINTER
403 001022 012777 000040 177560 A: MOV #40,@CS ;INIT
404 001030 016777 177644 177552 MOV DRVN,@CS ;DRIVE NUMBER
405 001036 016777 177640 177566 MOV UDES,@C2 ;UNIT DESCRIPTION
406 001044 016777 177636 177530 MOV WCNT,@WC ;WORD COUNT
407 001052 016777 177626 177526 MOV FCNT,@FC ;FRAME COUNT
408 001060 012102 MOV (R1)+,R2 ;SET OP CODE
409 001062 022702 000030 CMP #30,R2 ;SEE IF SPACE FORWARD
410 001066 001403 BEQ AA ;IF SO: BR
411 001070 022702 000032 CMP #32,R2 ;SEE IF SPACE REVERSE
412 001074 001003 BNE A0 ;IF NOT: BR
413 001076 012777 177777 177502 AA: MOV #-1,@FC ;SET TO SPACE ONE RECORD
414 001104 022702 000060 A0: CMP #60,R2 ;SEE IF READ OP
415 001110 103404 BLO A1 ;IF SO: BR
416 001112 016777 177574 177464 MOV WADDR,@BA ;SET WRITE ADDRESS
417 001120 000413 BR A3
418 001122 016777 177562 177454 A1: MOV RADDR,@BA ;SET READ ADDRESS
419 001130 022702 000070 CMP #70,R2 ;SEE IF READ OPERATION
420 001134 001405 BEQ A3 ;IF SO: BR
421 001136 016703 177542 MOV FCNT,R3 ;GET FRAME COUNT
422 001142 005403 NEG R3
423 001144 060377 177434 ADD R3,@BA ;SET BUS ADDRESS FOR READ REVERSE
424 001150 052702 000001 A3: BIS #1,R2 ;SET GO BIT
425 001154 000240 NOP
426 001156 000240 NOP
427 001160 010277 177414 MOV R2,@C1 ;START OPERATION
428 001164 000240 NOP
429 001166 000240 NOP
430 001170 016704 177522 MOV RDYDX,R4 ;SET DELAY MULTIPLIER
431 001174 016703 177514 BO: MOV RDYDLY,R3 ;SET READY DELAY
432 001200 032777 000200 177404 B: BIT #200,@DS
433 001206 001005 BNE C ;IF DRY: BR
434 001210 005303 DEC R3
435 001212 001372 BNE B
436 001214 005304 DEC R4
437 001216 001366 BNE B0 ;DELAY FOR DRIVE READY
438 001220 000240 NOP
439 001222 005777 177410 C: TST @SWR ;SEE IF STOP ON OPERATION
440 001226 100001 BPL D ;IF NOT: BR
441 001230 000000 HALT
442 001232 000240 D: NOP
443 001234 000240 NOP
444 001236 016704 177460 MOV OPDX,R4 ;SET DELAY MULTIPLIER
445 001242 016703 177452 E0: MOV OPDLY,R3 ;SET OPERATION DELAY
446 001246 005303 E: DEC R3
447 001250 001376 BNE E
448 001252 005304 DEC R4
449 001254 001372 BNE E0 ;DELAY BETWEEN OPERATIONS
450 001256 004767 000056 JSR PC,RWND ;GO SEE IF REWIND
451 001262 005300 DEC R0
    
```

```

452 001264 001256      BNE      A          ;IF SEQUENCE NOT DONE: BR
453
454 001266 032777 040000 177342  BIT      #40000,ASWR ;SEE IF HALT ON SEQUENCE
455 001274 001641      BEQ      START
456 001276 000000      HALT
457 001300 000167 177474  JMP      START
458
459                      ;RH REGISTER SETUP*****
460
461 001304 000240      SETUP:  NOP
462 001306 016701 177266  MOV      C1,R1      ;GET ADDRESS OF CS1
463 001312 012700 000015  MOV      #15,R0     ;SET NUMBER OF REGISTERS
464 001316 012702 000602  MOV      #WC,R2     ;GET FIRST ADDRESS
465 001322 062701 000002  SETA:   ADD      #2,R1 ;INCREMENT
466 001326 010122  MOV      R1,(R2)+   ;LOAD ADDRESS
467 001330 005300      DEC      R0         ;SEE IF DONE
468 001332 001373      BNE      SETA       ;IF NOT: BR
469 001334 000167 177440  JMP      START      ;ELSE GO START EXECUTION
470
471                      ;REWIND FROM EOT (PER SW13)
472
473 001340 032777 020000 177270  RWND:   BIT      #20000,ASWR ;SEE IF IGNORE EOT
474 001346 001033      BNE      RWNDX      ;IF SO: BR
475 001350 032777 002000 177234  BIT      #2000,ADS  ;SEE IF AT EOT
476 001356 001427      BEQ      RWNDX      ;IF NOT: BR
477 001360 012777 000040 177222  MOV      #40,ACS   ;IN
478 001366 016777 177306 177214  MOV      DRVM,ACS  ;SET DRIVE NUMBER
479 001374 016777 177302 177230  MOV      UDES,AC2  ;SET SLAVE NUMBER
480 001402 012777 000007 177170  MOV      #7,AC1   ;START REWIND
481 001410 032777 000200 177174  RWNDA:  BIT      #200,ADS ;SEE IF DRY
482 001416 001774      BEQ      RWNDA     ;IF NOT: BR
483 001420 032777 020000 177164  RWNDB:  BIT      #20000,ADS ;SEE IF PIP RESET
484 001426 001374      BNE      RWNDB     ;IF NOT: BR
485 001430 005726      TST      (SP)+     ;RESET STACK
486 001432 000167 177342  JMP      START     ;RESTART SEQUENCE
487 001436 000207      RWNDX:  RTS      PC ;RETURN
488
489                      . =2000
490                      .REPT 100
491                      0
492                      .ENDR
493
494                      . =3000
495                      .REPT 100
496                      177777
497                      .ENDR
498
499                      .END
    
```

A	001022	CC	000620	ER	000614	RADDR	000710	START	001000
AA	001076	CS	000610	EO	001242	RDYDLY	000714	SWR	000636
AS	000616	C1	000600	FC	000606	RDYDX	000716	UDES	000702
A0	001104	C2	000632	FCNT	000704	RWND	001340	WADDR	000712
A1	001122	D	001232	MR	000624	RWDA	001410	WC	000602
A3	001150	DB	000622	OPDLY	000720	RWNDB	001420	WCNT	000706
B	001200	DRVM	000700	OPDX	000722	RWDX	001436	.	= 003200
BA	000604	DS	000612	OPNUM	000724	SETA	001322		
BO	001174	DT	000626	OPTBL	000726	SETUP	001304		
C	001222	E	001246	PSW	000634	SN	000630		

. ABS. 003200 000

ERRORS DETECTED: 0

,CZTUMA.SEQ/SOL CZTUMA.P11
RUN-TIME: 24.2 SECONDS
RUN-TIME RATIO: 9/7=1.3
CORE USED: 5K (10 PAGES)