

PDP11

RANDOM EXERCISER
MD-11-DCQKA-C

EP-DCQKA-C-DL-A
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FICHE 1 OF 1

NOV 1976
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MADE IN USA

The microfiche strip contains approximately 15 frames. Each frame displays a different view of data, likely related to the 'RANDOM EXERCISER' mentioned in the header. The data is presented in a structured, tabular format with multiple columns and rows. Some frames appear to contain binary or hexadecimal data, while others show more complex patterns or diagrams. The text is small and difficult to read due to the resolution of the scan.

.REM %

IDENTIFICATION

PRODUCT CODE: MAINDEC-11-DCQKA-C-D
PRODUCT NAME: MUL - DIV RANDOM EXERCISER
DATE RELEASED: SEPTEMBER, 1976
MAINTAINER: DIAGNOSTIC GROUP
AUTHOR: BOB BRAIN

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DCQKAC.SRC

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DESCRIPTION

1. ABSTRACT
 THIS TEST IS TO BE USED AS AN EXERCISER FOR THE PDP11/45 MUL AND DIV INSTRUCTIONS. IT TESTS THE DIVIDE AND MULTIPLY WITH RANDOM NUMBERS.
2. REQUIREMENTS
 - 2.1 EQUIPMENT
 PDP11/45 STANDARD COMPUTER
 - 2.2 STORAGE
 PROGRAM STORAGE - THE ROUTINES USE MEMORY 0 - 17776
 - 2.3 PRELIMINARY PROGRAMS
 MAINDEC-11-DCKBI AND DCKBJ
3. LOADING PROCEDURE
 USE STANDARD PROCEDURE FOR ABS TAPES.
4. STARTING PROCEDURE
 - 4.1 CONTROL SWITCH SETTINGS
 SEE 5.1.1 (ALL DOWN FOR WORST CASE TESTING)
 - 4.2 STARTING ADDRESS
 THE PROGRAM SHOULD ALWAYS BE STARTED AT 200.
 - 4.3 PROGRAM AND/OR OPERATOR ACTION
 - 1) LOAD PROGRAM INTO MEMORY USING ABS LOADER.
 - 2) LOAD ADDRESS 200.
 - 3) SET SWITCHES (SEE SEC 5.1.1) ALL DOWN FOR WORST CASE
 - 4) PRESS START.
 - 5) THE PROGRAM WILL LOOP AND BELL WILL RING ONCE EVERY PASS
 - 6) A MINIMUM OF TWO PASSES SHOULD ALWAYS BE RUN.
 - 7) THE DISPLAY ON THE 11/45 WILL SHOW THE PASS COUNT. SET THE DATA DISPLAY SWITCH TO THE DISPLAY POSITION.

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DESCRIPTION

5. OPERATING PROCEDURE

5.1 OPERATIONAL SWITCH SETTINGS

AT SA 200 . . ALL SWITCHES DOWN WILL TEST ALL FUNCTIONS OF
MUL AND DIV AND PRINT OUT ON ERRORS AND CONTINUE IN TEST.
(BELL WILL RING AT COMPLETION OF 512 PASSES)

5.1.1 SWITCH SETTINGS ARE:

SW15 = 1 HALT ON ERROR
SW14 = 1 SCOPE LOOP
SW13 = 1 INHIBIT PRINTOUT
SW12 = 1 INHIBIT TRACE TRAPPING
SW11 = 1 INHIBIT ITERATION LOOP
SW10 = 1 BELL ON ERROR
0 BELL ON 512 PASSES

5.2 SUBROUTINE ABSTRACTS

5.2.1 SCOPE

THIS SUBROUTINE CALL IS PLACED BETWEEN EACH SUBTEST IN THE
INSTRUCTION SECTION. IT RECORDS THE STARTING ADDRESS OF
EACH SUBTEST AS IT IS BEING ENTERED IN LOCATION "LAD". IF A
SCOPE LOOP IS REQUESTED, THE CURRENT SUBTEST WILL BE LOOPED
UPON. SW<11> ON A 1 INHIBITS ITERATION OF SUBTESTS. THE
CONTENTS OF LAD MAY BE USED TO DETERMINE THE LAST SUBTEST
SUCCESSFULLY COMPLETED.

5.2.2 HLT

THIS ROUTINE PRINTS OUT AN ERROR MESSAGE (SEE 6.1.) TO
INHIBIT TYPEOUTS, PUT SW<13> ON A 1.

5.2.3 TRTRAP

IF SW<12> IS ON A 0, THE T BIT WILL BE SET ON ALTERNATE
PASSES. WHEN SET, IT CAUSES A TRAP AFTER EACH INSTRUCTION.
THE FIRST INSTRUCTION EXECUTED UPON TRAPPING IS AN "RTT"
WHICH RETURNS TO THE INTERRUPTED SEQUENCE OF INSTRUCTIONS.
THIS SEQUENCE IS CONTINUED UNTIL THE END OF THE PROGRAM IS
REACHED.

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DESCRIPTION

5.2.4 TRAPCATCHER

A ".+2" - "HALT" SEQUENCE IS REPEATED FROM 0 - 776 TO CATCH ANY UNEXPECTED TRAPS. THUS ANY UNEXPECTED TRAPS OR INTERRUPTS WILL HALT AT THE VECTOR + 2.

6. ERRORS

LOADING AND STARTING AT 200 WITH ALL SWITCHES DOWN IS WORST CASE TESTING. WHEN AN ERROR IS DETECTED AND IT IS NECESSARY TO SCOPE ON IT, PLACE SW15 UP TO HALT ON ERROR, HIT CONTINUE WITH SW14 UP TO LOOP ON TEST, AND SW13 UP TO DELETE PRINTOUTS.

6.1 ERROR PRINTOUT

THE FORMAT IS AS FOLLOWS:

DIV ERROR: 040000 000000 / 100000

SOFTWARE 000000 100000 PS=22
HARDWARE 000000 100000 PS=122

ERRORS OCCURED 75 TIMES OUT OF 400

THE LINE STARTING WITH 'DIV ERROR' IS THE OPERATION BEING PERFORMED WHEN THE FAILURE WAS DETECTED. THE 'SOFTWARE' LINE SHOWS THE CALCULATED RESULT AND THE 'HARDWARE' LINE IS THE RESULT BY THE HARDWARE. THE LAST LINE REFLECTS THE NUMBER OF ERRORS OUT OF THE NUMBER OF TRIES. THIS LINE WILL ONLY BE TYPED IF THE ITERATIONS ARE ON.

6.2 ERROR RECOVERY

RESTART AT 200

7. RESTRICTIONS

NONE

8. MISCELLANEOUS

8.1 EXECUTION TIME

A BELL WILL RING WITHIN 1 MINUTE WITH ALL SWITCHES DOWN.

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DESCRIPTION

8.2 STACK POINTER

STACK IS INITALLY SET TO 500

8.3 POWER FAIL

TO USE, START THE TEST AS USUAL AND POWER DOWN THEN UP AT ANY TIME. THERE SHOULD BE NO ERROR TYPEOUTS.

9. PROGRAM DESCRIPTION

THIS PROGRAM IS AN EXERCISER OF THE MULTIPLY AND DIVIDE INSTRUCTIONS. IT FIRST GENERATES 2 RANDOM NUMBERS AND MULTIPLIES THEM TOGETHER. IT SAVES THIS ANSWER AND DIVIDES IT BY THE MULTIPLIER AND THE MULTIPLICAN SAVING BOTH ANSWERS. THE ORIGINAL NUMBERS ARE HARDWARE MULTIPLIED BOTH WAYS AND COMPARED TO THE ORIGINAL ANSWER. THE TWO DIVISIONS ARE PERFORMED AND COMPARED TO THE ORIGINAL SOFTWARE ANSWERS. ONE MORE RANDOM NUMBER IS GENERATED AND THIS NUMBER IS DIVIDED INTO THE ORIGINAL TWO NUMBERS AND THE ANSWER CHECKED AGAINST THE HARDWARE ANSWERS. EACH HARDWARE MULTIPLY AND DIVIDE IS DONE 256 TIMES. IF SW11 IS UP, THEY WILL ONLY BE DONE ONCE. SW14 WILL CAUSE THE TEST THAT YOU ARE IN TO BE LOOPED UPON.

%

295 .TITLE MAINDEC-11-DCQKA-C MUL - DIV RANDOM EXERCISER
296 ;COPYRIGHT 1972, 1976 DIGITAL EQUIPMENT CORP., MAYNARD, MASS.
297 ;PROGRAM BY BOB BRAIN
298 ;ENABL ABS
299 ;SWITCH SETTINGS

300
301 ; SWITCH USE
302 ;-----
303 ; 10 0 - BELL ON PASS COMPLETE
304 ; 11 1 - BELL ON ERROR
305 ; 12 INHIBIT ITERATIONS
306 ; 13 INHIBIT TRACE TRAP
307 ; 14 INHIBIT ERROR TYPEOUTS
308 ; 15 LOOP ON TEST
309 ; HALT ON ERROR
310

311
312 000000 ;=0 ;TRAP CATCHER AT 0 - 776
313 000014 ;=14

314 000014 003640 .TRT
315 000016 000000 0
316 000020 003710 .IOT
317 000022 000340 340

318
319 000030 002206 ;=30 .EMT
320 000032 000000 0
321 000034 002372 .TRP
322 000036 000000 0
323 000046 000046 ;=46
324 000046 002124 \$ENDAD
325 000052 000052 ;=52
326 000052 000000 0

327 000200 000200 ;=200
328 000200 000167 000576 JMP BEGIN

329
330 000004 TYPE= IOT
331 040000 SW14= 40000
332 020000 SW13= 20000
333 010000 SW12= 10000
334 004000 SW11= 4000
335 002000 SW10= 2000

336 000001 N= 1
337 177570 SWR= 177570
338 177570 DISPLAY=SWR
339 104000 SCOPE= EMT
340 104400 HLT= TRAP

341 000000 R0= %0
342 000000 .AC= R0
343 000001 .MQ= %1
344 000002 R2= %2
345 000003 TTY= %3
346 000004 R4= %4
347 000005 R5= %5
348 000006 SP= %6
349 000007 PC= %7
350 000007 BELL= 7


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351          001000          . =1000
352
353 001000 000000          ICNT: 0
354 001002 012706 000500 BEGIN: MOV #500,SP ;SET PUSH DOWN LIST POINTER
355 001006 005067 002650 15: CLR ERRORS ;ERROR COUNT
356 001012 012767 000001 002632 MOV #1,CNT
357 001020 026737 001100 000042 CMP SENDAD,2#42 ;ARE WE IN AUTOMATIC MODE?
358 001026 001006 BNE .+16 ;NO, BRANCH
359 001030 012767 000060 002614 MOV #60,CNT ;ALLOW SHORTER PASS TIME FOR AUTO MODE
360 001036 012767 C00777 001142 MOV #777,EMT ;BRANCH-SELF ON ERROR SO PGM. TIMES OUT IN AUTO MODE
361 001044 012767 123456 002574 MOV #123456,LONUM ;INITALIZE LONUM FOR RANDOM
362 001052 012767 176543 002570 MOV #176543,HINUM ;INITALIZE HINUM FOR RANDOM
363
364 001060 012704 003666 GO: MOV #AREA,R4 ;SET POINTER TO ANSWER AREA
365 001064 004767 002330 JSR PC,RANDOM ;GET RANDOM NUMBERS
366 001070 016701 002552 MOV LONUM,MQ ;LOAD MULTIPLIER (SOFTWARE)
367 001074 016702 002550 MOV HINUM,R2 ;LOAD MULTIPLICAN (SOFTWARE)
368 001100 004767 003542 JSR PC,MUL1 ;MULTIPLY
369 001104 010124 MOV .MQ,(4)+ ;SAVE MQ
370 001106 010024 MOV .AC,(4)+ ;SAVE AC
371 001110 016724 003026 MOV SR1,(4)+ ;SAVE SR
372
373 001114 016702 002526 MOV LONUM,R2 ;LOAD DIVISOR
374 001120 004767 003022 JSR PC,DIV1 ;DIVIDE BY MULTIPLIER (SOFTWARE)
375 001124 010024 MOV .AC,(4)+ ;SAVE AC
376 001126 010124 MOV .MQ,(4)+ ;SAVE MQ
377 001130 016724 003006 MOV SR1,(4)+ ;SAVE SR
378
379 001134 005767 002506 TST LONUM
380 001140 001411 BEQ OK1
381 001142 005701 TST .MQ
382 001144 001402 BEQ .+6
383 001146 004767 002372 JSR PC,BAD
384 001152 020067 002472 CMP .AC,HINUM
385 001156 001432 BEQ .+6
386 001160 004767 002360 JSR PC,BAD
387 001164 012704 003666 OK1: MOV #AREA,R4 ;RESET POINTER
388 001170 012401 MOV (4)+,MQ ;RESTORE MQ
389 001172 012400 MOV (4)+,AC ;RESTORE AC
390 001174 062704 000010 ADD #10,R4 ;INCREMENT POINTER
391
392 001200 016702 002444 MOV HINUM,R2 ;LOAD DIVISOR
393 001204 004767 002736 JSR PC,DIV1 ;DIVIDE BY MULTIPLICAN (SOFTWARE)
394 001210 010024 MOV .AC,(4)+ ;SAVE AC
395 001212 010124 MOV .MQ,(4)+ ;SAVE MQ
396 001214 016714 002722 MOV SR1,(4) ;SAVE SR
397 001220 005767 002424 TST HINUM
398 001224 001411 BEQ ITER
399 001226 005701 TST .MQ
400 001230 001402 BEQ .+6
401 001232 004767 002306 JSR PC,BAD
402 001236 020067 002404 CMP .AC,LONUM
403 001242 001402 BEQ .+6
404 001244 004767 002274 JSR PC,BAD
405 001250 005067 177524 ITER: CLR ICNT ;SET UP COUNT
    
```

J01

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409 001254 104000
410 001256 012704 003666
411 001262 012467 003706
412 001266 012467 003700
413 001272 011467 002644
414
415 001276 016700 002344
416 001302 070067 002342
417 001306 004767 000626
418 001312 000240
419 001314 026700 003652
420 001320 001401
421 001322 104400
422 001324 026701 003644
423 001330 001401
424 001332 104400
425 001334 126767 002602 000640
426 001342 001401
427 001344 104400
428
429

```
*****  
;TEST 1 LONUM X HINUM  
*****  
SCOPE  
MOV #AREA,R4 ;RESTORE POINTER  
MOV (4)+,MQX ;RESTORE MQ  
MOV (4)+,ACX ;RESTORE AC  
MOV (4),SRI ;RESTORE SRI  
  
MOV LONUM,.AC ;LOAD MULTIPLIER (HARDWARE)  
MUL HINUM,.AC ;LOAD MULTIPLICAN AND MULTIPLY  
JSR PC,FLOW  
NOP  
CMP .ACX,.AC ;CHECK HIGH ORDER PRODUCT  
BEQ .+4 ;SKIP IF OK  
HLT  
CMP .MQX,.MQ ;CHECK LOW ORDER PRODUCT  
BEQ .+4 ;SKIP IF OK  
HLT  
CMPB SRI,TEMP ;CHECK STATUS REGISTER  
BEQ .+4 ;SKIP IF GOOD  
HLT
```

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431
432 001346 104000
433 001350 012704 003666
434 001354 012467 003614
435 001360 012467 003606
436 001364 011467 002552
437
438 001370 016700 002254
439 001374 070067 002246
440 001400 004767 000534
441 001404 000240
442 001406 026700 003560
443 001412 001401
444 001414 104402
445 001416 026701 003552
446 001422 001401
447 001424 104402
448 001426 126767 002510 000546
449 001434 001401
450 001436 104402

```
*****  
;TEST 2 HINUM X LONUM  
*****  
SCOPE  
MOV #AREA,R4 ;RESTORE POINTER  
MOV (4)+,MQX ;RESTORE MQ  
MOV (4)+,ACX ;RESTORE AC  
MOV (4),SRI ;RESTORE SRI  
  
MOV HINUM,.AC ;LOAD MULTIPLIER (HARDWARE)  
MUL LONUM,.AC ;MULTIPLY  
JSR PC,FLOW  
NOP  
CMP .ACX,.AC ;CHECK HIGH ORDER PRODUCT  
BEQ .+4 ;SKIP IF OK  
HLT+2  
CMP .MQX,.MQ ;CHECK LOW ORDER PRODUCT  
BEQ .+4 ;SKIP IF OK  
HLT+2  
CMPB SRI,TEMP ;CHECK STATUS REGISTER  
BEQ .+4 ;SKIP IF GOOD  
HLT+2
```

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452
453
454 001440 104000
455 001442 012704 003666
456 001446 012401
457 001450 012400
458 001452 005724
459 001454 012467 003512
460 001460 012467 003510
461 001464 011467 002452
462

```
*****  
;TEST 3 RESULT / LONUM  
*****  
SCOPE  
MOV #AREA,R4 ;RESTORE POINTER  
MOV (4)+,MQ ;RESTORE MQ  
MOV (4)+,AC ;RESTORE AC  
TST (4)+ ;INCREMENT POINTER  
MOV (4)+,ACX ;RESTORE AC  
MOV (4)+,MQX ;RESTORE MQ  
MOV (4),SRI ;RESTORE SRI
```

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463 001470 071067 002152          DIV      LONUM, AC      ;DIVIDE BY MULTIPLIER (HARDWARE)
464 001474 004767 000440          JSR      PC, FLOW
465 001500 000410                    BR       .SR1
466 001502 026700 003464          CMP      .ACX, .AC      ;CHECK REMAINDER
467 001506 001401                    BEQ      .+4             ;SKIP IF OK
468 001510 104401                    HLT+1
469 001512 026701 003456          CMP      .MQX, .MQ      ;CHECK QUOTENT
470 001516 001401                    BEQ      .+4             ;SKIP IF OK
471 001520 104401                    HLT+1
472 001522 126767 002414 000452 .SR1:  CMPB     SR1, TEMP      ;CHECK STATUS REGISTER
473 001530 001401                    BEQ      .+4             ;SKIP IF OK
474 001532 104401                    HLT+1
475
476                                     ;*****
477                                     ;TEST 4          RESULT / HINUM
478                                     ;*****
479 001534 104000                    SCOPE
480 001536 012704 003666          MOV      #AREA, R4      ;RESTORE POINTER
481 001542 012401                    MOV      (4)+, .MQ      ;RESTORE MQ
482 001544 012400                    MOV      (4)+, .AC      ;RESTORE AC
483 001546 062704 000010          ADD      #10, R4        ;INCREMENT POINTER
484 001552 012467 003414          MOV      (4)+, .ACX     ;RESTORE AC
485 001556 012467 003412          MOV      (4)+, .MQX     ;RESTORE MQ
486 001562 011467 002354          MOV      (4), SR1      ;RESTORE SR1
487
488 001566 071067 002056          DIV      HINUM, AC      ;DIVIDE BY MULTIPLICAN (HARDWARE)
489 001572 004767 000342          JSR      PC, FLOW
490 001576 000410                    BR       .SR2
491 001600 026700 003366          CMP      .ACX, .AC      ;CHECK REMAINDER
492 001604 001401                    BEQ      .+4             ;SKIP IF OK
493 001606 104403                    HLT+3
494 001610 026701 003360          CMP      .MQX, .MQ      ;CHECK QUOTENT
495 001614 001401                    BEQ      .+4             ;SKIP IF OK
496 001616 104403                    HLT+3
497 001620 126767 002316 000354 .SR2:  CMPB     SR1, TEMP      ;CHECK STATUS REGISTER
498 001626 001401                    BEQ      .+4             ;SKIP IF OK
499 001630 104403                    HLT+3

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MAINDEC-11-DCQKA-C MUL - DIV RANDOM EXERCISER MACY11 27(732) 21-JUN-76 13:39 PAGE 11
DCQKAC.SRC T4 RESULT / HINUM

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500 001632 104000                    SCOPE          ;CALCULATE NEW RANDOM DIVISOR
501 001634 016767 002006 002024  MOV      LONUM, AREA    ;GET MQ
502 001642 016767 002002 002020  MOV      HINUM, AREA+2 ;GET AC
503 001650 016701 001772          MOV      LONUM, .MQ     ;LOAD MQ (SOFTWARE)
504 001654 016700 001770          MOV      HINUM, .AC     ;LOAD AC (SOFTWARE)
505 001660 004767 001534          JSR      PC, RANDOM    ;GET 1 RANDOM NUMBER
506 001664 016767 001756 002000  MOV      LONUM, AREA+4 ;GET DIVISOR
507 001672 016702 001750          MOV      LONUM, R2     ;LOAD THE DIVISOR
508 001676 004767 002244          JSR      PC, DIVI      ;DIVIDE
509 001702 010067 003264          MOV      .AC, .ACX
510 001706 010167 003262          MOV      .MQ, .MQX
511 001712 012767 001720 001736  MOV      #LOCX, LAD    ;FUDGE LAD
512
513                                     ;*****
514                                     ;TEST 5          LONUM HINUM / NEW LONUM
515                                     ;*****
516
517 001720 016701 001742          LOCX:  MOV      AREA, .MQ ;RESTORE MQ
518 001724 016700 001740          MOV      AREA+2, .AC   ;RESTORE AC
519 001730 071067 001736          DIV      AREA+4, .AC   ;DIVIDE
520 001734 004767 000200          JSR      PC, FLOW
521 001740 000410                    BR       .SR3
522 001742 026700 003224          CMP      .ACX, .AC      ;CHECK AC

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523 001746 001401 BEQ .L01
524 001750 104407 HLT+7 ;REMAINDER WRONG
525 001752 026701 003216 CMP .MQX,.MQ ;CHECK QUOTIENT
526 001756 001401 BEQ .+4
527 001760 104407 HLT+7 ;QUOTIENT WRONG
528 001762 126767 002154 000212 .SR3: CMPB SR1,TEMP ;CHECK STATUS
529 001770 001401 BEQ .+4
530 001772 104407 HLT+7
531

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MAINDEC-11-DCQKA-C MUL - DIV RANDOM EXERCISER MACY11 27(732) 21-JUN-76 13:39 PAGE 12
DCQKAC.SRC T BIT AND LOOPING

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532 001774 104000 SCOPE
533
534 001776 005046 CLR -(6) ;CLEAR TRACE TRAP
535 002000 032767 010000 175562 BIT #SW12,SWR ;RUN WITH TRT? *SW12*
536 002006 001010 BNE 2$
537 002010 005167 000170 COM TRPB
538 002014 100005 BPL 2$
539 002016 052716 000020 BIS #20,(6) ;SET TRACE TRAP
540 002022 012746 001060 MOV #GO,-(6) ;JUMP TO START OF TEST
541 002026 000006 RTT
542 002030 012746 002036 2$: MOV #RTIX,-(6) ;JUMP TO START OF TEST
543 002034 000006 RTT
544 002036 062767 000001 001606 RTIX: ADD #1,CNT ;COUNT NUMBER OF PASSES
545 002044 016737 001602 177570 MOV CNT,#DISPLAY
546 002052 032767 000177 001572 BIT #177,CNT ;CHECK FOR MULTIPLES OF 200
547 002060 001402 BEQ .+6
548 002062 000167 176772 DOIT: JMP GO ;RERUN
549 002066 032767 002000 175474 BIT #2000,SWR
550 002074 001372 BNE DOIT
551 002076 005067 001550 CLR CNT
552 002102 112767 000007 001550 MOVB #BELL,.TYPE ;TYPE A BELL
553 002110 000004 003660 TYPE .TYPE
554 002114 013700 000042 MOV #42,RO ;GET MONITOR ADDRESS (IF ANY)
555 002120 001405 BEQ AGAIN
556 002122 000005 RESET
557 002124 004710 SENDAD: JSR 7,(0) ;CALL THE MONITOR
558 002126 000240 NOP
559 002130 000240 NOP
560 002132 000240 NOP
561 002134 000167 176720 AGAIN: JMP GO ;RERUN
562
563
564 002140 113767 177776 000034 FLOW: MOVB #177776,TEMP ;GET THE PS BITS
565 002146 042767 177760 000026 BIC #177760,TEMP
566 002154 032767 000002 000020 BIT #2,TEMP
567 002162 001003 BNE EQ2
568 002164 062716 000002 ADD #2,(6)
569 002170 000207 RTS PC
570 002172 042767 000014 000002 EQZ: BIC #14,TEMP
571 002200 000207 RTS PC
572
573 002202 000000 TEMP: 0
574 002204 000000 TRPB: 0

```

MAINDEC-11-DCQKA-C MUL - DIV RANDOM EXERCISER MACY11 27(732) 21-JUN-76 13:39 PAGE 13
DCQKAC.SRC SCOPE ROUTINE

```

575 002206 032737 004000 177570 .EMT: BIT #SW11,#SWR ;KILL ITERATIONS
576 002214 001053 BNE SAVLAD
577 002216 005767 176556 TST ICNT
578 002222 001445 BEQ ICINT ;BRANCH IF FIRST

```

```

579 002224 032737 040000 177570 BIT #SW10,2#SWR ;KILL ITERATIONS
580 002232 001047 BNE KIT ;YES
581 002234 026767 001424 176536 CMP TIMES, ICNT ;DONE?
582 002242 003042 BGT KIT ;BRANCH IF NOT
583 002244 005767 001404 TST ERCNT ;ANY ERRORS?
584 002250 001432 BEQ ICINT
585 002252 032737 020000 177570 BIT #SW13,2#SWR ;INHIBIT TYPEOUTS?
586 002260 001024 BNE NOTY
587 002262 000004 003202 TYPE ER6
588 002266 016703 001362 MOV ERCNT, TTY ;TYPE ERCNT IN OCTAL
589 002272 004767 001510 JSR PC, PRINTS ;AND SUPPRESS LEADING ZERO'S
590 002276 000004 003226 TYPE ER7
591 002302 016703 176472 MOV ICNT, TTY ;TYPE ICNT IN OCTAL

```

```

;AND SUPPRESS LEADING ZERO'S
593 002312 000004 002316 TYPE .+2 ;ASCIZ <15><12>
594 002322 005737 177570 TST 2#SWR ;HALT ON ERROR *SW15*
595 002326 100001 BPL .+4
596 002330 000000 HALT
597 002332 005067 001316 NOTY: CLR ERCNT
598 002336 012767 000001 176434 ICINT: MOV #1, ICNT ;FIRST ITERATION
599 002344 011667 001306 SAVLAD: MOV (6), LAD ;SAVE LOOP ADDRESS
600 002350 000002 RTI ;RETURN
601
602 002352 005267 176422 KIT: INC ICNT
603 002356 005767 001274 OVR: TST LAD ;FIRST ONE?
604 002362 001770 BEQ SAVLAD
605 002364 016716 001266 MOV LAD, (6) ;FUDGE RETURN ADDRESS
606 002370 000002 RTI ;FIXES PS

```

MAINDEC-11-DCQKA-C MUL - DIV RANDOM EXERCISER MACY11 27(732) 21-JUN-76 13:39 PAGE 14
DCQKAC.SRC ERROR ROUTINES

```

607 002372 032737 002000 177570 .TRP: BIT #SW10,2#SWR ;BELL ON ERROR?
608 002400 001405 BEQ .ET
609 002402 112767 000007 001250 MOV #BELL, .TYPE ;TYPE A BELL
610 002410 000004 003660 TYPE .TYPE
611 002414 005767 001234 .ET: TST ERCNT ;CHECK FOR FIRST ERROR
612 002420 001402 BEQ .+6
613 002422 000167 000412 NOH: JMP NOHEAD
614 002426 011667 000422 MOV (6), HLTAD ;SAVE ADDRESS OF HLT
615 002432 005267 001224 INC ERRORS ;COUNT THE NUMBER OF ERRORS
616 002436 132737 000001 000041 BITB #1,2#41 ;AUTO RUN?
617 002444 001412 BEQ 1$ ;NO!
618 002446 022767 000010 001206 CMP #10, ERRORS ;TOO MANY ERRORS
619 002454 001006 BNE 1$ ;NOT YET!
620 002456 013700 000042 MOV 2#42, R0 ;GET ADDRESS
621 002462 001403 BEQ 1$ ;NONE????
622 002464 005037 000042 CLR 2#42 ;ZERO IT
623 002470 004710 JSR PC, (0) ;RETURN TO MONITOR
624 002472 032767 020000 175070 1$: BIT #SW13, SWR ;SKIP TYPEOUT IF SET
625 002500 001350 BNE NOH
626 002502 011646 MOV (6), -(6) ;PUT ADDRESS OF INSTRUCTION ON STACK
627 002504 162716 000002 SUB #2, (6) ;GET THE INSTRUCTION
628 002510 032776 000001 000000 BIT #1, 2(6) ;TEST FOR MULTIPLY OR DIVIDE
629 002516 001034 BNE DIVP ;GOTO DIVIDE PRINT IF ON A 1

```

```

630 002520 000004 003101          TYPE      ,NO1
631 002524 032776 000002 000000  BIT      #2,2(6)      ;TEST FOR WHICH MULTIPLY
632 002532 001413          BEQ      SECO
633 002534 016703 001106          MOV      LONUM,TTY ;TYPE LONUM IN OCTAL
634 002540 004767 001232          JSR      PC,PRINTR ;TYPE LEADING ZERO'S
635 002544 000004 003122          TYPE      ,ER2
636 002550 016703 001074          MOV      HINUM,TTY ;TYPE HINUM IN OCTAL
637 002554 004767 001216          JSR      PC,PRINTR ;TYPE LEADING ZERO'S
638 002560 000462          BR      PSOFT
639 002562          SECO:
640 002562 016703 001062          MOV      HINUM,TTY ;TYPE HINUM IN OCTAL
641 002566 004767 001204          JSR      PC,PRINTR ;TYPE LEADING ZERO'S
642 002572 000004 003122          TYPE      ,ER2
643 002576 016703 001044          MOV      LONUM,TTY ;TYPE LONUM IN OCTAL
644 002602 004767 001170          JSR      PC,PRINTR ;TYPE LEADING ZERO'S
645 002606 000447          BR      PSOFT

```

MAINDEC-11-DCQKA-C MUL - DIV RANDOM EXERCISER MACY11 27(732) 21-JUN-76 13:39 PAGE 15
DCQKAC.SRC ERROR ROUTINES

```

646 002610 000004 003060          DIVP:  TYPE      ,ER1D
647 002614 016703 001050          MOV      AREA+2,TTY ;TYPE AREA+2 IN OCTAL
648 002620 004767 001152          JSR      PC,PRINTR ;TYPE LEADING ZERO'S
649 002624 112757 000040 001026  MOVVB   #40,TYPE ;TYPE A 40
650 002632 000004 003660          TYPE      ,TYPE
651 002636 016703 001024          MOV      AREA,TTY ;TYPE AREA IN OCTAL
652 002642 004767 001130          JSR      PC,PRINTR ;TYPE LEADING ZERO'S
653 002646 000004 003126          TYPE      ,ER2A
654 002652 032776 000004 000000  BIT      #4,2(6)
655 002660 001405          BEQ      DIVZ
656 002662 016703 001004          MOV      AREA+4,TTY ;TYPE AREA+4 IN OCTAL
657 002666 004767 001104          JSR      PC,PRINTR ;TYPE LEADING ZERO'S
658 002672 000415          BR      PSOFT
659 002674 032776 000002 000000  DIVZ:  BIT      #2,2(6) ;TEST FOR WHICH DIVIDE
660 002702 001005          BNE     SECI
661 002704 016703 000736          MOV      LONUM,TTY ;TYPE LONUM IN OCTAL
662 002710 004767 001062          JSR      PC,PRINTR ;TYPE LEADING ZERO'S
663 002714 000404          BR      PSOFT
664 002716          SECI:
665 002716 016703 000726          MOV      HINUM,TTY ;TYPE HINUM IN OCTAL
666 002722 004767 001050          JSR      PC,PRINTR ;TYPE LEADING ZERO'S
667 002726 000004 003132          PSOFT: TYPE      ,ER3
668 002732 016703 002234          MOV      ,ACX,TTY ;TYPE ,ACX IN OCTAL
669 002736 004767 001034          JSR      PC,PRINTR ;TYPE LEADING ZERO'S
670 002742 000004 003165          TYPE      ,ER4
671 002746 016703 002222          MOV      ,MQX,TTY ;TYPE ,MQX IN OCTAL
672 002752 004767 001020          JSR      PC,PRINTR ;TYPE LEADING ZERO'S
673 002756 000004 003172          TYPE      ,ER5
674 002762 016703 001154          MOV      ,SRI,TTY ;TYPE SRI IN OCTAL
675 002766 004767 001014          JSR      PC,PRINTS ;AND SUPPRESS LEADING ZERO'S
676 002772 000004 003152          TYPE      ,ER3B
677 002776 000004 003145          TYPE      ,ER3A
678 003002 010003          MOV      ,AC,TTY ;TYPE ,AC IN OCTAL
679 003004 004767 000766          JSR      PC,PRINTR ;TYPE LEADING ZERO'S
680 003010 000004 003165          TYPE      ,ER4
681 003014 010103          MOV      ,MQ,TTY ;TYPE ,MQ IN OCTAL
682 003016 004767 000754          JSR      PC,PRINTR ;TYPE LEADING ZERO'S
683 003022 000004 003172          TYPE      ,ER5
684 003026 016703 177150          MOV      TEMP,TTY ;TYPE TEMP IN OCTAL
685 003032 004767 000750          JSR      PC,PRINTS ;AND SUPPRESS LEADING ZERO'S
686 003036 005726          TST     (6)+ ;RESTORE POINTER
687 003040 021667 000010          NOHEAD: CMP     (6),HLTAD ;CHECK FOR SAME HLT
688 003044 001002          BNE     ,+6
689 003046 005267 000602          INC     ERCNT

```

691	003054	000000			MLTAD:	0	
692	003056	000000			SER:	0	
693	003060	005015	042012	053111	ER10:	.ASCIZ	<15><12><12>"DIV ERROR: "
694	003066	042440	051122	051117			
695	003074	020072	020040	000			
696	003101	015	005012	052515	ER11:	.ASCIZ	<15><12><12>"MUL ERROR: "
697	003106	020114	051105	047522			
698	003114	035122	020040	000040			
699	003122	054040	000040		ER2:	.ASCIZ	" X "
700	003126	027440	000040		ER2A:	.ASCIZ	" / "
701	003132	005015	051412	043117	ER3:	.ASCII	<15><12><12>"SOFTWARE"
702	003140	053524	051101	105			
703	003145	040	020040	000040	ER3A:	.ASCIZ	" "
704	003152	005015	040510	042122	ER3B:	.ASCIZ	<15><12>"HARDWARE"
705	003160	040527	042522	000			
706	003165	040	020040	000040	ER4:	.ASCIZ	" "
707	003172	020040	020040	051520	ER5:	.ASCIZ	" PS="
708	003200	000075					
709	003202	005015	042412	051122	ER6:	.ASCIZ	<15><12><12>"ERRORS OCCURRED "
710	003210	051117	020123	041517			
711	003216	052503	051122	042105			
712	003224	000040					
713	003226	052040	046511	051505	ER7:	.ASCIZ	" TIMES OUT OF "
714	003234	047440	052125	047440			
715	003242	020106	000				
716	003245	015	000012		CRL:	.ASCIZ	<15><12>
717	003250	005015	047523	052106	ERNG:	.ASCII	<15><12>"SOFTWARE DIVIDE DOESN'T MATCH REAL ANSWER. "
718	003256	040527	042522	042040			
719	003264	053111	042111	020105			
720	003272	047514	051505	023516			
721	003300	020124	040515	041524			
722	003306	020110	042522	046101			
723	003314	040440	051516	042527			
724	003322	027122	020040				
725	003326	047514	020103	020075	E1:	.ASCIZ	"LOC = "
726	003334	000					
727	003335	015	027012	041501	E2:	.ASCIZ	<15><12>".AC = "
728	003342	036440	000040				
729	003346	020040	020040	046456	E3:	.ASCIZ	" .M0 = "
730	003354	020121	020075	000			
731	003361	040	020040	046040	E4:	.ASCIZ	" LONUM = "
732	003366	047117	046525	036440			
733	003374	000040					
734	003376	020040	020040	044510	E5:	.ASCIZ	" HINUM = "
735	003404	052516	020115	020075			
736	003412	000					
737	003413	015	005012	000	E6:	.ASCIZ	<15><12><12>
738	003420					.EVEN	

739	003420	010046			RANDOM:	MOV	.AC, -(6)	:SAVE R0
740	003422	010146				MOV	.M0, -(6)	:SAVE R1
741	003424	010246				MOV	R2, -(6)	:SAVE R2
742	003426	010446				MOV	R4, -(6)	:SAVE R4
743	003430	016700	000212			MOV	LONUM, .AC	:SET R0 WITH LOW
744	003434	016701	000210			MOV	HINUM, .M0	:SET R1 WITH HIGH
745	003440	012704	177771			MOV	#-7, R4	:SET SHIFT COUNT

746 003441 005002
 747 003446 006300
 748 003450 006101
 749 003452 006102
 750 003454 005204
 751 003456 001373
 752 003460 066702 000162
 753 003464 005501
 754 003466 066701 000156
 755 003472 005502
 756 003474 062700 001057
 757 003500 005501
 758 003502 005502
 759 003504 062701 047401
 760 003510 005502
 761 003512 062702 000006
 762 003516 060200
 763 003520 005501
 764 003522 010067 000120
 765 003526 010167 000116
 766 003532 012604
 767 003534 012602
 768 003536 012601
 769 003540 012600
 770 003542 000207

15:

CLR R0
 ASL .AC
 ROL .MQ
 ROL R2
 INC R4
 BNE 15
 ADD LONUM,R2
 ADC .MQ
 ADD HINUM,.MQ
 ADC R2
 ADD #1057,.AC
 ADC .MQ
 ADC R2
 ADD #47401,.MQ
 ADC R2
 ADD #6,R2
 ADD R2,.AC
 ADC .MQ
 MOV .AC,LONUM
 MOV .MQ,HINUM
 MOV (6)+,R4
 MOV (6)+,R2
 MOV (6)+,.MQ
 MOV (6)+,.AC
 RTS PC

C02

;SHIFT R0 LEFT AND
 ;ROTATE CARRY INTO R1 AND
 ;ROTATE CARRY INTO R2
 ;CHECK FOR DONE
 ;CONTINUE SHIFT LOOP
 ;ADD NUMBER TO MAKE X 129
 ;PROPOGATE CARRY
 ;ADD NUMBER TO MAKE X 129
 ;PROPOGATE CARRY
 ;ADD LOW CONSTANT
 ;PROPOGATE CARRY
 ;PROPOGATE CARRY
 ;ADD HIGH CONSTANT
 ;PROPOGATE CARRY
 ;ADD HIGHEST CONSTART
 ;REPRIME R0 WITH HIGHEST DIGIT
 ;PROPOGATE CARRY
 ;SAVE R0
 ;SAVE R1
 ;RESTORE R4
 ;RESTORE R2
 ;RESTORE R1
 ;RESTORE R0
 ;RETURN

771
 772
 773 003544 000004 003250
 774 003550 011603
 775 003552 004767 000230
 776 003556 000004 003335
 777 003562 010003
 778 003564 004767 000206
 779 003570 000004 003346
 780 003574 010103
 781 003576 004767 000174
 782 003602 000004 003361
 783 003606 016703 000034
 784 003612 004767 000160
 785 003616 000004 003376
 786 003622 016703 000022
 787 003626 004767 000144
 788 003632 000004 003413
 789 003636 000207

BAD:

TYPE ERNG
 MOV (6) TTY
 JSR PC,PRINTS
 TYPE E2
 MOV .AC,TTY
 JSR PC,PRINTR
 TYPE E3
 MOV .MQ,TTY
 JSR PC,PRINTR
 TYPE E4
 MOV LONUM,TTY
 JSR PC,PRINTR
 TYPE E5
 MOV HINUM,TTY
 JSR PC,PRINTR
 TYPE E6
 RTS PC

;TYPE (5) IN OCTAL
 ;AND SUPRESS LEADING ZERO'S
 ;TYPE .AC IN OCTAL
 ;TYPE LEADING ZERO'S
 ;TYPE .MQ IN OCTAL
 ;TYPE LEADING ZERO'S
 ;TYPE LONUM IN OCTAL
 ;TYPE LEADING ZERO'S
 ;TYPE HINUM IN OCTAL
 ;TYPE LEADING ZERO'S

MAINDEC-11-DCQKA-C MUL - DIV RANDOM EXERCISER
 DCQKAC.SRC RANDOM NUMBER GENERATOR

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790 003640 000006
 791 003642 000000
 792 003644 000000
 793 003646 000000
 794 003650 000000
 795 003652 000000
 796 003654 000000
 797 003656 000000
 798 003660 000000
 799 003662 000000
 800 003664 000400
 801
 802 003666 000000
 803 003670 000000
 804 003672 000000
 805 003674 000000

.TRT: RTT
 TAD: 0
 TLOC: 0
 LONUM: 0
 HINUM: 0
 CNT: 0
 ERCNT: 0
 LAD: 0
 .TYPE: 0
 EFRORS: 0
 TIMES: 256.
 AREA: 0
 0
 0
 0

;TRAP ADDRESS
 ;TRAP LOCATION
 ;RANDOM NUMBER #1
 ;RANDOM NUMBER #2
 ;PASS NUMBER
 ;ERROR COUNT
 ;LOOP ADDRESS
 ;CHARACTER TYPING LOCATION
 ;ERRORS ENCOUNTERED

;MQ (MULTIPLY) DIVIDEND RIGHT
 ;AC (MULTIPLY) DIVIDEND LEFT
 ;SR (MULTIPLY) DIVISOR
 ;AC (DIVIDE BY LONUM)

806 003676 000000
 807 003700 000000
 808 003702 000000
 809 003704 000000
 810 003706 000000
 811
 812 003710 010346
 813 003712 017603 000002
 814 003716 105713
 815 003720 001406
 816 003722 112337 177566
 817 003726 105737 177564
 818 003732 100375
 819 003734 000770
 820
 821 003736 017646 000002
 822 003742 062766 000002 000004
 823 003750 022666 000002
 824 003754 001006
 825 003756 062703 000002
 826 003762 042703 000001
 827 003766 010366 000002
 828 003772 012603
 829 003774 000002

002

0
 0
 0
 0
 0
 .IOT: MOV TTY, -(6) ;SAVE TTY
 MOV #2(6), TTY ;GET ADDRESS TO BE TYPED
 15: TSTB (TTY) ;TERMINATOR?
 BEQ 25
 MOV (TTY)+, #177566 ;LOAD AND TYPE THE CHARACTER
 TSTB #177564 ;IS THE PRINTER READY
 BPL -4
 BR 15 ;GET THE NEXT CHARACTER
 25: MOV #2(6), -(6) ;GET ADDRESS TO BE TYPED
 ADD #2, 4(6) ;ADD 2 TO THE ADDRESS
 CMP (6)+, 2(6) ;IS IT .+2?
 BNE 35 ;NO
 ADD #2, TTY ;ADD 2 TO THE ADDRESS
 BIC #1, TTY ;BACK UP TO AN EVEN BYTE
 MOV TTY, 2(6) ;RESTORE ADDRESS
 35: MOV (6)+, TTY ;RESTORE TTY
 RTI ;RETURN

MAINDEC-11-DC9KA-C MUL - DIV RANDOM EXERCISER MACY11 27(732) 21-JUN-76 13:39 PAGE 19
 DC9KAC.SRC OCTAL DUMP OF A WORD

830 003776 112767 000001 000130
 831 004004 000402
 832 004006 005067 000122
 833 004012 112767 177772 000115
 834 004020 010446
 835 004022 012704 004124
 836 004026 105014
 837 004030 000405
 838 004032 105014
 839 004034 006103
 840 004036 106114
 841 004040 006103
 842 004042 106114
 843 004044 006103
 844 004046 106114
 845 004050 105714
 846 004052 001402
 847 004054 105267 000054
 848 004056 105767 000050
 849 004058 001402
 850 004066 152724 000060
 851 004072 105267 000037
 852 004076 001355
 853 004100 022704 004124
 854 004104 001002
 855 004106 112724 000060
 856 004112 105014
 857 004114 000004 004124
 858 004120 012604
 859 004122 000207
 860
 861 004124 000004
 862 004134 000000

PRINTR: MOV #1, R45 ;SET ZERO FILL SWITCH
 BR .+6
 PRINTS: CLR R45 ;SUPPRESS LEADING ZERO'S
 MOV #8-6, R45+1 ;SET COUNT
 MOV R4, -(6) ;SAVE R4
 MOV #35, R4 ;SET POINTER TO FIRST ASCII CHAR.
 CLRB (4) ;CLEAR FIRST BYTE
 BR 25 ;ROTATE FIRST BIT
 15: CLRB (4) ;CLEAR BYTE OF CHARACTER
 ROL TTY ;ROTATE BIT INTO C
 ROLB (4) ;PACK IT
 ROL TTY ;ROTATE BIT INTO C
 ROLB (4) ;PACK IT
 25: ROL TTY ;ROTATE BIT INTO C
 ROLB (4) ;PACK IT
 TSTB (4)
 BEQ .+6
 INCB R45
 TSTB R45 ;CHECK FILL SWITCH
 BEQ .+6
 BISB #'0, (4)+ ;MAKE INTO ASCII CHAR
 INCB R45+1
 BNE 15 ;REPEAT
 CMP #35, R4
 BNE .+6
 MOV #'0, (4)+
 CLRB (4)
 TYPE 35 ;TYPE IT
 MOV (6)+, R4 ;RESTORE R4
 RTS PC
 35: .BLKW 4
 R45: 0

MAINDEC-11-DC9KA-C MUL - DIV RANDOM EXERCISER MACY11 27(732) 21-JUN-76 13:39 PAGE 20
 DC9KAC.SRC MULTIPLY AND DIVIDE ROUTINES

E02

```

; DIVIDE SUBROUTINE
863
864
865 004136 000000 Z: .WORD 0
866 004140 000000 COUNT: .WORD 0
867 004142 000000 SR1: .WORD 0
868 004144 000000 SINE: .WORD 0
869
870
871 004146 005702 DIVI: TST R2
872 004150 001004 BNE DIVL
873 004152 012767 000003 177762 MOV #3,SR1
874 004160 000207 RTS PC
875 004162 012767 177760 177750 DIVL: MOV #-16.,COUNT ;SET UP STEP COUNTER
876 004170 005067 177746 CLR SR1
877 004174 005067 177744 CLR SINE
878 004200 005700 TST .AC
879 004202 100002 BPL .+6
880 004204 105167 177734 COMB SINE
881 004210 005067 177722 STEP1: CLR Z ;INITIALIZE Z INDICATORS
882 004214 000241 CLC
883 004216 005700 TST .AC ;CHECK REMAINDER SIGN
884 004220 100002 BPL .+6
885 004222 105167 177711 COMB Z+1
886 004226 005700 TST R2 ;CHECK DIVISOR SIGN
887 004230 100002 BPL .+6
888 004232 105167 177701 COMB Z+1
889 004236 105767 177675 TSTB Z+1 ;-1 IF DIFFERENT, 0 IF SAME
890 004242 100403 BMI .+8.
891 004244 005267 177666 INC Z ;SET Z=1 IF SAME
892 004250 000261 SEC ;SET C TO A 1
893 004252 006101 ROL .MQ ;ROTATE AC AND MQ ONCE LEFT STEP2
894 004254 006100 ROL .AC
895 004256 105767 177654 TSTB Z ;STEP3
896 004262 001406 BEQ .+14.
897 004264 160200 SUB R2,.AC ;SUBTRACT IF Z = 1
898 004266 106167 177653 ROLB SINE+1
899 004272 105167 177647 COMB SINE+1
900 004276 000403 BR .+8.
901 004300 060200 ADD R2,.AC ;ADD IF Z = 0
902 004302 106167 177637 ROLB SINE+1
903 004306 022767 177760 177624 CMP #-16.,COUNT ;CHECK FOR FIRST TIME THROUGH STEP4
904 004314 001014 BNE STEP8

```

MAINDEC-11-DCGKA-C MUL - DIV RANDOM EXERCISER MACY11 27(732) 21-JUN-76 13:39 PAGE 21
 DCGKAC.SRC MULTIPLY AND DIVIDE ROUTINES

```

905 004316 005700 STEP6: TST .AC
906 004320 001412 BEQ STEP8
907 004322 106067 177617 RORB SINE+1
908 004326 103404 BCS .+10. ;IF C AND DIVIDEND ARE
909 004330 105767 177610 TSTB SINE ;
910 004334 100431 BMI OFLW ; DIFFERENT, AN OVERFLOW
911 004336 000403 BR .+8. ; HAS OCCURRED
912 004340 105767 177600 TSTB SINE
913 004344 100025 BPL OFLW
914
915 004346 005267 177566 STEP8: INC COUNT
916 004352 001402 BEQ .+6
917 004354 000167 177630 JMP STEP1
918
919 004360 005700 TST .AC ;BEGINNING OF CORRECTION ROUTINE
920 004362 001022 BNE STEP9 ;IF THE REMAINDER IS ZERO
921 004364 000261 STEP10: SEC ; SHIFT THE QUOTIENT ONCE

```

```

922 004366 006101          ROL      F02
923 004370 116705 177550 STP9:  MOV8   SINE,R5
924 004374 005702          TST     R2
925 004376 100001          BPL     .+4
926 004400 005105          COM     R5
927 004402 005705          TST     R5
928 004404 100403          BMI     .+8.
929 004406 005701          TST     .MQ
930 004410 100403          BMI     OFLW
931 004412 000465          BR      DONX
932 004414 005701          TST     .MQ
933 004416 003463          BLE     DONX
934 004420 052767 000002 177514 OFLW:  BIS     #2,SR1
935 004426 000207          RTS     PC
936
937
938 004430 010267 177504          STEP9: MOV     R2,COUNT
939 004434 100402          BMI     .+6
940 004436 005467 177476          NEG     COUNT
941 004442 020067 177472          CMP     .AC,COUNT
942 004446 001416          BEQ     STEP11
943
944 004450 105067 177463          CLR8   Z+1
945 004454 005700          TST     .AC
946 004456 100002          BPL     .+6
947 004460 105167 177453          COM8   Z+1
948 004464 105767 177454          TST8   SINE
949 004470 100002          BPL     .+6
950 004472 105167 177441          COM8   Z+1
951 004476 105767 177435          TST8   Z+1
952 004502 001730          BEQ     STEP10

```

; FILLING WITH "1"
; IF THE DIVISOR WAS (+) NEGATE IT
; IF THE SAME AS REMAINDER, GO
; TO STEP 11
; COMPARE THE SIGNS OF THE
; REMAINDER AND THE
; DIVIDEND. IF THEY
; ARE THE SAME, GO TO
; STEP 10

MAINDEC-11-DCCKA-C MUL - DIV RANDOM EXERCISER MACY11 27(732) 21-JUN-76 13:39 PAGE 22
DCCKAC.SRC MULTIPLY AND DIVIDE ROUTINES

```

953 004504 005067 177426          STEP11: CLR     Z
954 004510 005700          TST     .AC
955 004512 100002          BPL     .+6
956 004514 105167 177417          COM8   Z+1
957 004520 005702          TST     R2
958 004522 100002          BPL     .+6
959 004524 105167 177407          COM8   Z+1
960 004530 105767 177403          TST8   Z+1
961 004534 001003          BNE     .+8.
962 004536 005267 177374          INC     Z
963 004542 005201          INC     .MQ
964 004544 000241          CLC
965 004546 006101          ROL     .MQ
966
967 004550 105767 177362          TST8   Z
968 004554 001402          BEQ     .+6
969 004556 160200          SUB     R2,.AC
970 004560 000703          BR      STP9
971 004562 060200          ADD     R2,.AC
972 004564 000701          BR      STP9
973
974 004566 010046          DONX:  MOV     .AC,-(6)
975 004570 010100          MOV     .MQ,.AC
976 004572 012601          MOV     (6)+,.MQ
977 004574 005700          TST     .AC
978 004576 001003          BNE     .+8.
979 004600 052767 000004 177334          BIS     #4,SR1
980 004606 005700          DONE:  TST     .AC
981 004610 100003          BPL     .+8.

```

; SET Z=1 IF REMAINDER AND
; THE DIVISOR HAVE THE
; SAME SIGN
; ADD Z TO QUOTIENT
; SHIFT QUOTIENT LEFT ONCE
; FILLING WITH "0"
; SUBTRACT DIVISOR FROM REMAINDER
; ADD DIVISOR TO REMAINDER

```

982 004612 052767 000010 177322   BIS   #0,PC
983 004620 005700               TST   .AC
984 004622 001005               BNE   NXT
985 004624 005701               TST   .MQ
986 004626 001003               BNE   NXT
987 004630 052767 000004 177304   BIS   #4,SR1
988 004636 000207               RTS   PC

```

MAINDEC-11-DCQKA-C MUL - DIV RANDOM EXERCISER MACY11 27(732) 21-JUN-76 13:39 PAGE 23
DCQKAC.SRC MULTIPLY AND DIVIDE ROUTINES

```

989 ; MULTIPLY SUBROUTINE
990
991 004640 000000   CONT: .WORD 0
992 004642 000000   ONE:  .WORD 0
993 004644 000000   CHEK: .WORD 0
994
995 004646 005067 177770   MUL1: CLR   ONE ;CLEAR Z STEP1
996 004652 005067 177264   CLR   SR1
997 004656 005067 177762   CLR   CHEK
998 004662 005000               CLR   .AC ;CLEAR AC
999 004664 005701               TST   .MQ
1000 004665 100002               BPL   .+6
1001 004670 005167 177750   COM   CHEK
1002 004674 005702               TST   R2
1003 004676 100002               BPL   .+6
1004 004700 005167 177740   COM   CHEK
1005 004704 012767 177760 177726   MOV   #-16,CONT ;INITIALIZE COUNT
1006 004712 022701 100000   CMP   #100000,.MQ
1007 004716 001011               BNE   CNXT
1008 004720 005702               TST   R2
1009 004722 100023               BPL   STEP2
1010 004724 010200               MOV   R2,.AC
1011 004726 005400               NEG   .AC
1012 004730 000241               CLC
1013 004732 005001               CLR   .MQ
1014 004734 006000               ROR   .AC
1015 004736 006001               ROR   .MQ
1016 004740 000451               BR    DONE2
1017 004742 022702 100000   CNXT: CMP   #100000,R2
1018 004746 001011               BNE   STEP2
1019 004750 005701               TST   .MQ
1020 004752 100007               BPL   STEP2
1021 004754 010100               MOV   .MQ,.AC
1022 004756 005400               NEG   .AC
1023 004760 000241               CLC
1024 004762 005001               CLR   .MQ
1025 004764 006000               ROR   .AC
1026 004766 006001               ROR   .MQ
1027 004770 000435               BR    DONE2
1028 004772 105067 177645   STEP2: CLRB  ONE+1
1029 004776 132767 000001 177636   BITB  #1,ONE
1030 005004 001402               BEQ   .+6
1031 005006 105167 177631   COMB  ONE+1 ;COMP ONE+1 IF Z=1
1032 005012 032701 000001               BIT   #1,.MQ
1033 005016 001402               BEQ   .+6
1034 005020 105167 177617   COMB  ONE+1 ;COMP ONE+1 IF R1 IS ODD
1035 005024 105767 177613   TSTB  ONE+1 ;IF THE LOW ORDER BIT IS THE SAME
1036 005030 001402               BEQ   STEP4 ;AS Z, GO TO STEP4

```

MAINDEC-11-DCQKA-C MUL - DIV RANDOM EXERCISER MACY11 27(732) 21-JUN-76 13:39 PAGE 24
DCQKAC.SRC MULTIPLY AND DIVIDE ROUTINES

```

1037 005032 032701 000001   STEP3: BIT   #1,.MQ

```


J02

*	PC	=:000007	349#	365*	368*	374*	383*	386*	393*	401*	404*	417*	440*	464*	489
*			505*	508*	520*	569*	571*	589*	592*	623*	634*	637*	641*	644*	648
*			652*	657*	662*	666*	669*	672*	675*	679*	682*	685*	770*	775*	778
			781*	784*	787*	789*	859*	874*	935*	988*					
	PRINTR	003776	634	637	641	644	648	652	657	662	666	669	672	679	682
			778	781	784	787	830#								
	PRINTS	004006	589	592	675	685	775	832#							
	PSOFT	002726	638	645	658	663	667#								
	RANDOM	003420	365	505	739#										
	RTIX	002036	542	544#											
	RO	=:000000	341#	342	554*	620*									
*	R2	=:000002	344#	367*	373*	392*	507*	741	746*	749*	752*	755*	758*	760*	761
			762	767*	871	886	897	901	924	938	957	969	971	1002	1008
			1010	1017	1039	1041									
*	R4	=:000004	346#	364*	387*	390*	410*	433*	455*	480*	483*	742	745*	750*	766
			834	835*	853	858*									
	RS	=:000005	347#	923*	926*	927									
	SAVLAD	002344	576	599#	604										
	SCOPE	= 104000	339#	409	432	454	479	500	532						
	SECI	002716	660	664#											
	SECO	002562	632	639#											
	SER	003056	692#												
	SINE	004144	868#	877*	880*	898*	899*	902*	907*	909	912	923	948		
	SP	=:000006	348#	354*											
	SR1	004142	371	377	396	413*	425	436*	448	461*	472	486*	497	529	674
			867#	873*	876*	934*	979*	982*	987*	996*	1069*	1073*			
	STEP1	004210	881#	917											
	STEP10	004364	921#	952											
	STEP11	004504	942	953#											
	STEP2	004772	1009	1018	1020	1028#	1047								
	STEP3	005032	1037#												
	STEP4	005046	1036	1042#											
	STEPS	005056	1046#												
	STEP6	004316	905#												
	STEP8	004346	904	906	915#										
	STEP9	004430	920	938#											
	STP9	104370	923#	970	972										
	SWR	= 177570	337#	338	535	549	575	579	585	594	607	624			
	SW10	= 102000	335#	607											

MAINDEC-11-DCQKA-C MUL - DIV RANDOM EXERCISER MACY11 27(732) 21-JUN-76 13:39 PAGE 28
 DCQKAC.SRC CROSS REFERENCE TABLE -- USER SYMBOLS

	SW11	= 004000	334#	575											
	SW12	= 010000	333#	535											
	SW13	= 020000	332#	585	624										
	SW14	= 040000	331#	579											
	TAD	003642	791#												
	TEMP	002202	425	448	472	497	528	564*	565*	566	570*	573#	684		
	TIMES	003664	581	800#											
	TLOC	003644	792#												
	TRPB	002204	537#	574#											
*	TTY	=:000003	345#	588*	591*	633*	636*	640*	643*	647*	651*	656*	661*	665*	668
			671*	674*	678*	681*	684*	774*	777*	780*	783*	786*	812	813*	814

ADC	753	755	757	758	760	763	1055	1061							
ADD	390	483	544	568	752	754	756	759	761	762	822	825	901	971	1039
ASL	747														
ASR	1042														
BCS	908														
BEQ	380	382	385	398	400	403	420	423	426	443	446	449	467	470	473
	492	495	498	523	526	529	547	555	578	584	604	608	612	617	621
	632	655	815	846	849	896	906	916	942	952	968	1030	1033	1036	1049
	1064														
BGT	582														
BIC	565	570	826												
BIS	539	934	979	982	987	1069	1073								
BISB	850														
BIT	535	546	549	566	575	579	585	607	624	628	631	654	659	1032	1037
BITB	616	1029													
BLE	933														
BMI	890	910	928	930	939	1051	1059	1068							
BNE	358	536	550	567	576	580	586	619	625	629	660	688	751	824	852
	854	872	904	920	961	978	984	986	1007	1018	1038	1047	1066		
BPL	538	595	818	879	884	887	913	925	946	949	955	958	981	1000	1003
	1009	1020	1053	1072											
BR	465	490	521	638	645	658	663	819	831	837	900	911	931	970	972
	1016	1027	1040	1057											
CLC	882	964	1012	1023											
CLR	355	405	534	551	597	622	746	832	876	877	881	953	995	996	997
	998	1013	1024												
CLRB	836	838	856	944	1028										
CMP	357	384	402	419	422	442	445	466	469	491	494	522	525	581	618
	687	823	853	903	941	1006	1017	1065							
CMPB	425	448	472	497	528										
COM	537	926	1001	1004											
COMB	880	885	888	899	947	950	956	959	1031	1034					
DIV	463	488	519												
EMT	339														
HALT	313	596													
INC	602	615	689	750	891	915	962	963	1046						
INCB	847	851													
IOT	330														
JMP	328	548	561	613	917	1070	1074								
JSR	365	368	374	383	386	393	401	404	417	440	464	489	505	508	520
	557	589	592	623	634	637	641	644	648	652	657	662	666	669	672
	675	679	682	685	775	778	781	784	787						
MOV	354	356	359	360	361	362	364	366	367	369	370	371	373	375	376
	377	387	388	389	392	394	395	396	410	411	412	413	415	433	434
	435	436	438	455	456	457	459	460	461	480	481	482	484	485	486

	501	502	503	504	506	507	MO2	510	511	517	518	540	542	545	554
	589	591	598	599	605	614	620	626	633	636	640	643	647	651	658
	661	665	668	671	674	678	681	684	739	740	741	742	743	744	749
	764	765	766	767	768	769	774	777	780	783	786	812	813	821	827
	828	834	835	858	873	875	938	974	975	976	1005	1010	1021		
MOVE	552	564	609	649	816	830	833	855	923						
MUL	416	439													
NEG	940	1011	1022	1054	1056	1060	1062								
NOP	418	441	558	559	560										
RESET	556														
ROL	748	749	839	841	843	893	894	922	965						

MAINDEC-11-DCQKA-C MUL - DIV RANDOM EXERCISER MACY11 27(732) 21-JUN-76 13:39 PAGE 33
 DCQKAC.SRC CROSS REFERENCE TABLE -- PERMANENT SYMBOLS

ROLB	840	842	844	898	902	1044									
ROR	1014	1015	1025	1026	1043										
RORB	907														
RTI	600	606	690	829											
RTS	569	571	770	789	859	874	935	988							
RTT	541	543	790												
SEC	892	921													
SUB	627	897	969	1041											
TRAP	340														
TST	379	381	397	399	458	577	583	594	603	611	686	871	878	883	886
	905	919	924	927	929	932	945	954	957	977	980	983	985	999	1002
TSTB	1008	1019	1048	1050	1052	1058	1063	1067	1071						
.ASCII	814	817	845	848	889	895	909	912	948	951	960	967	1035		
.ASCIZ	701	717													
	594	693	696	699	700	703	704	706	707	709	713	718	725	727	729
	731	734	737												
.BLKW	861														
.ENABL	298														
.END	1080														
.EVEN	594	738													
.LIST	296	313	351	406	479	429	432	451	454	476	479	514	517	532	575
	594	607	739	830	863										
.MACR	351														
.MACRO	351														
.MLIST	296	313	351	406	409	429	432	451	454	476	479	514	517	532	575
	594	607	739	830	863										
.REM	1														
.REPT	313														
.SBTTL	296	351	406	429	451	476	514	532	575	607	739	830	863		
.TITLE	295														
.WORD	865	866	867	868	991	992	993								

ERRORS DETECTED: 0
 DEFAULT GLOBALS GENERATED: 0

*DCQKAC,DCQKAC/SOL/PAGNUM/CRF=DCQKAC.SRC
 RUN-TIME: 3 6 1 SECONDS
 RUN-TIME RATIO: 136/12=10.8

CORE USED: 7K (13 PAGES)

N02

