

PDP11

RANDOM EXERCISER
MD-11-DCQKA-C

EP-DCQKA-C-DL-A
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NOV 1976
digital
MADE IN USA

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401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500
501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540	541	542	543	544	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560	561	562	563	564	565	566	567	568	569	570	571	572	573	574	575	576	577	578	579	580	581	582	583	584	585	586	587	588	589	590	591	592	593	594	595	596	597	598	599	600
601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620	621	622	623	624	625	626	627	628	629	630	631	632	633	634	635	636	637	638	639	640	641	642	643	644	645	646	647	648	649	650	651	652	653	654	655	656	657	658	659	660	661	662	663	664	665	666	667	668	669	670	671	672	673	674	675	676	677	678	679	680	681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699	700
701	702	703	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720	721	722	723	724	725	726	727	728	729	730	731	732	733	734	735	736	737	738	739	740	741	742	743	744	745	746	747	748	749	750	751	752	753	754	755	756	757	758	759	760	761	762	763	764	765	766	767	768	769	770	771	772	773	774	775	776	777	778	779	780	781	782	783	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800
801	802	803	804	805	806	807	808	809	810	811	812	813	814	815	816	817	818	819	820	821	822	823	824	825	826	827	828	829	830	831	832	833	834	835	836	837	838	839	840	841	842	843	844	845	846	847	848	849	850	851	852	853	854	855	856	857	858	859	860	861	862	863	864	865	866	867	868	869	870	871	872	873	874	875	876	877	878	879	880	881	882	883	884	885	886	887	888	889	890	891	892	893	894	895	896	897	898	899	900
901	902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917	918	919	920	921	922	923	924	925	926	927	928	929	930	931	932	933	934	935	936	937	938	939	940	941	942	943	944	945	946	947	948	949	950	951	952	953	954	955	956	957	958	959	960	961	962	963	964	965	966	967	968	969	970	971	972	973	974	975	976	977	978	979	980	981	982	983	984	985	986	987	988	989	990	991	992	993	994	995	996	997	998	999	1000

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DCQKAC.SRC

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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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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.

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.

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.

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MAINDEC-11-DCQKA-C MUL - DIV RANDOM EXERCISER MACY11 27(732) 21-JUN-76 13:39 PAGE 7
DCQKAC.SRC

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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 ;          15              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 .=30
319 000030 002206 .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 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, #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          ;INITIALIZE LONUM FOR RANDOM
362 001052 012767 176543 002570 MOV #176543, HINUM          ;INITIALIZE 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

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 DCQKAC.SRC T1 LONUM X HINUM

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406
407
408
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
430
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

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;*****
;TEST 1 LONUM X HINUM
;*****
SCOPE
MOV #AREA,R4 ;RESTORE POINTER
MOV (4)+,MQX ;RESTORE MQ
MOV (4)+,ACX ;RESTORE AC
MOV (4),SR1 ;RESTORE SR1

MOV LONUM,.AC ;LOAD MULTIPLIER (HARDWARE)
MUL HINUM,.AC ;LOAD MULTIPLICAND 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 SR1,TEMP ;CHECK STATUS REGISTER
BEQ .+4 ;SKIP IF GOOD
HLT

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```

;*****
;TEST 2 HINUM X LONUM
;*****
SCOPE
MOV #AREA,R4 ;RESTORE POINTER
MOV (4)+,MQX ;RESTORE MQ
MOV (4)+,ACX ;RESTORE AC
MOV (4),SR1 ;RESTORE SR1

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 SR1,TEMP ;CHECK STATUS REGISTER
BEQ .+4 ;SKIP IF GOOD
HLT+2

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DCQKA-C 1005100000 DIV RANDOM EXERCISER MACY11 27(732) 21-JUN-76 13:39 PAGE 10
 DCQKAC.SRC T3 RESULT / LONUM

```

451
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

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;*****
;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),SR1 ;RESTORE SR1

```

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							
478							
479	001534	104000					
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		

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

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							
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

```

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

```

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

```

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$: MOV #RTIX,-(6) ;JUMP TO START OF TEST
543 002034 000006 RTT
544 002036 062767 000001 001606 RTIX: ADD #1,CNT ;COUNT NUMBER OF PASSES
545 002044 016737 001602 177570 MOV CNT,2$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 EQ2: 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 #SW11,2$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 #SW1,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,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

```

```

1A1HPRINTS ;AND SUPPRESS LEADING ZERO'S
593 002312 000004 002316 TYPE ;ASCIZ <15><12>
594 002322 005737 177570 TST ;HALT ON ERROR *SW15*
595 002326 100001 BPL ;+4
596 002330 000000 HALT ;+4
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,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,SW41 ;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 SW42,R0 ;GET ADDRESS
621 002462 001403 BEQ 1$ ;NONE????
622 002464 005037 000042 CLR SW42 ;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,SW(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	ER10	
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	MOV	#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)	
660	002702	001005			BNE	SECI	;TEST FOR WHICH DIVIDE	
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	.SR1,TTY	;TYPE SR1 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		

MAINDEC-11-DCQKA-C MUL - DIV RANDOM EXERCISER
DCQKAC.SRC ERROR ROUTINES

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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: .ASCIZ <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: .ASCIZ <15><12>"SOFTWARE DIVIDE DOESN'T MATCH REAL ANSWER. "
718 003256 040527 042522 042040
719 003264 053111 042111 020105
720 003272 047514 051504 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 " .MQ = "
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

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

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739 003420 010046          RANDOM: MOV .AC, -(6)      ;SAVE R0
740 003422 010146          MOV .MQ, -(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, .MQ    ;SET R1 WITH HIGH
745 003440 012704 177771    MOV #-7, R4    ;SET SHIFT COUNT

```


ADDRESS	HEX	ASCII	OPERATION	COMMENT
806	003676	000000		
807	003700	030000		
808	003702	000000		
809	003704	000000		
810	003706	000000		
811				
812	003710	010346	.IOT: MOV	TTY, -(6)
813	003712	017603	MOV	2(6), TTY
814	003716	105713	15: TSTB	(TTY)
815	003720	001406	BEO	25
816	003722	112337	MOVb	(TTY)+, 2#177566
817	003726	105737	TSTB	2#177564
818	003732	100375	BPL	-4
819	003734	000770	BR	15
820				
821	003736	017646	25: MOV	2(6), -(6)
822	003742	062766	ADD	#2, 4(6)
823	003750	022666	CMP	(6)+, 2(6)
824	003754	001006	BNE	35
825	003756	062703	ADD	#2, TTY
826	003762	042703	BIC	#1, TTY
827	003766	010366	MOV	TTY, 2(6)
828	003772	012603	35: MOV	(6)+, TTY
829	003774	000002	RTI	

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

Address	Hex	Dec	Label	Op	Opnd	Comment
830	003776	112767	000001	000130	PRINTR: MOVB	#1,R4S ;SET ZERO FILL SWITCH
831	004004	000402			BR	.+6
832	004006	000067	000122		PRINTS: CLR	R4S ;SUPPRESS LEADING ZERO'S
833	004012	112767	177772	000115	MOVB	#-6,R4S+1 ;SET COUNT
834	004020	010446			MOV	R4,-(6) ;SAVE R4
835	004022	012704	004124		MOV	#3\$,R4 ;SET POINTER TO FIRST ASCII CHAR.
836	004026	105014			CLRB	(4) ;CLEAR FIRST BYTE
837	004030	000405			BR	2\$;ROTATE FIRST BIT
838	004032	105014	1\$:		CLRB	(4) ;CLEAR BYTE OF CHARACTER
839	004034	006103			ROL	TTY ;ROTATE BIT INTO C
840	004036	106114			ROLB	(4) ;PACK IT
841	004040	006103			ROL	TTY ;ROTATE BIT INTO C
842	004042	106114			ROLB	(4) ;PACK IT
843	004044	006103	2\$:		ROL	TTY ;ROTATE BIT INTO C
844	004046	106114			ROLB	(4) ;PACK IT
845	004050	105714			TSTB	(4)
846	004052	001402			BEQ	.+6
847	004054	105267	000054		INCB	R4S
848	004056	105767	000050		TSTB	R4S ;CHECK FILL SWITCH
849	004054	001402			BEQ	.+6
850	004056	152724	000060		BISB	#'0,(4)+ ;MAKE INTO ASCII CHAR
851	004072	105267	000037		INCB	R4S+1
852	004076	001355			BNE	1\$;REPEAT
853	004100	022704	004124		CMP	#3\$,R4
854	004104	001002			BNE	.+6
855	004106	112724	000060		MOVB	#'0,(4)+
856	004112	105014			CLRB	(4)
857	004114	000004	004124		TYPE	3\$;TYPE IT
858	004120	012604			MOV	(6)+,R4 ;RESTORE R4
859	004122	000207			RTS	PC
860						
861	004124	000004	3\$:		.BLKW	4
862	004134	000000	R4\$:		0	

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

E02

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863                                     ;      DIVIDE SUBROUTINE
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 005702      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
893 004252 006101      ROL     .MQ      ;SET C TO A 1
894 004254 006100      ROL     .AC      ;ROTATE AC AND MQ ONCE LEFT STEP2
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

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

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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

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922	004366	006101			ROL	502		
923	004370	116705	177550	STP9:	MOV8	SINE, R5		FILLING WITH "1"
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		; IF THE DIVISOR WAS (+) NEGATE IT
941	004442	020067	177472		CMP	.AC, COUNT		; IF THE SAME AS REMAINDER, GO
942	004446	001416			BEQ	STEP11		TO STEP 11
943								
944	004450	105067	177463		CLRB	Z+1		
945	004454	005700			TST	.AC		; COMPARE THE SIGNS OF THE
946	004456	100002			BPL	.+6		REMAINDER AND THE
947	004460	105167	177453		COMB	Z+1		DIVIDEND. IF THEY
948	004464	105767	177454		TSTB	SINE		ARE THE SAME, GO TO
949	004470	100002			BPL	.+6		STEP 10
950	004472	105167	177441		COMB	Z+1		
951	004476	105767	177435		TSTB	Z+1		
952	004502	001730			BEQ	STEP10		

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		; SET Z=1 IF REMAINDER AND
955	004512	100002			BPL	.+6		THE DIVISOR HAVE THE
956	004514	105167	177417		COMB	Z+1		SAME SIGN
957	004520	005702			TST	R2		
958	004522	100002			BPL	.+6		
959	004524	105167	177407		COMB	Z+1		
960	004530	105767	177403		TSTB	Z+1		
961	004534	001003			BNE	.+8.		
962	004536	005267	177374		INC	Z		
963	004542	005201			INC	.MQ		; ADD Z TO QUOTIENT
964	004544	000241			CLC			
965	004546	006101			ROL	.MQ		; SHIFT QUOTIENT LEFT ONCE
966								FILLING WITH "0"
967	004550	105767	177362		TSTB	Z		
968	004554	001402			BEQ	.+6		
969	004556	160200			SUB	R2, .AC		; SUBTRACT DIVISOR FROM REMAINDER
970	004560	000703			BR	STP9		
971	004562	060200			ADD	R2, .AC		; ADD DIVISOR TO REMAINDER
972	004564	000701			BR	STP9		
973								
974	004566	010746		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	DONE:	BIS	#4, SR1		
980	004606	005700			TST	.AC		
981	004610	100003			BPL	.+8.		

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		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		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	001406			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
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W02

[illegible]

[illegible]

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

[illegible]

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#											
	R0	=: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#											
	STEP5	005056	1046#												
	STEP6	004316	905#												
	STEP8	004346	904	906	915#										
	STEP9	004430	920	938#											
	STP9	004370	923#	970	972										
	SWR	= 177570	337#	338	535	549	575	579	585	594	607	624			
	SW10	= 002000	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	634	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												
ENT	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		
	701	717													
.ASCII2	594	693	696	699	700	703	704	706	707	709	713	716	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

[illegible]