

IDENTIFICATION:       DECIMAL OUTPUT I  
                          Subroutine

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ACCEPTED:              November 1, 1960

PURPOSE:               To convert a binary-scaled, single precision number  
                          to decimal form and print out the decimal number.

RESTRICTIONS:

1.   Q = Binary scaling  
       $0 \leq Q \leq 21$
2.   L = Desired number of decimal digits to print to  
      the left of the decimal point.  
       $0 \leq L \leq 7$
3.   R = Desired number of decimal digits to print to  
      the right of the decimal point.  
       $0 \leq R \leq 6$
4.   In addition, the following requirements exist:  
       $L + R \leq 7$ ; if  $L + R = 7$ , then  
       $|X \cdot 10^R| < 2^{21}$
5.   Note: If any of the above restrictions are not met,  
      the program will not provide any alarms, but will out-  
      put erroneous data.

SPACE:                 Sectors 000-306 of line 05 are used for the routine. All  
REQUIRED               of line 00 is used for temporary storage.

TIMING:                The timing of the program is dependent on the output  
                          typing speed of the Flexowriter - - about 10 characters/  
                          second.

ACCURACY:

The output number, N, is correctly rounded:

$$|X - N| \leq 5 \times 10^{-(R + 1)}$$

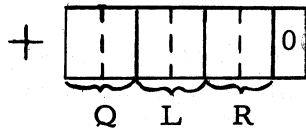
- Where
- X = Binary scaled number in A
  - N = Decimal output number typed
  - R = Number of digits printed to the right of the decimal point

USE:

1. Calling Sequence

LDA number to be converted @ Q  
 LDB keyword (see below)  
 LDC return instruction  
 TRU 015 05

The keyword is of the form



Q, L, and R are 2 octal digits each; the last octal digit must be zero and the keyword must be positive.

2. The decimal number, N, will be typed in the form

$$\text{sign } l_L \text{ --- } l_2 l_1 \cdot r_1 r_2 \text{ --- } r_R$$

The sign will be printed first as follows:

- a) Positive sign = space for  $N \geq 0$ .
- b) Negative sign = - for  $N < 0$ .

Leading zeroes before the decimal point are suppressed, except that if the number being converted = 0, then there is no zero-suppression.

METHOD:

The binary scaled number,  $X@Q$ , is transformed to a positive, decimally-scaled number,  $|X| \cdot 10^R @21$ , and rounded. Successive division by 10 will produce as remainders the decimal digits, least significant digit first, with the quotient providing the new dividend. When  $L + R$  remainders (digits) have been generated, these then provide the linkage to a corresponding WOC instruction. Zero suppression and decimal output are determined by counting each place during output, and comparing with  $L$  and  $R$ .

**pb Packard Bell Computer****PB 250 PROGRAM LISTING**PROBLEM DECIMAL OUTPUT SUBROUTINE I, APPENDIX BPAGE 1 OF 7PROGRAMMER P. JARVIEDATE 2-28-61

LOCATION	INSTRUCTION	SYMBOLIC OF CODE	REMARKS	
00005\$	014S6100;	WOC	CHARACTER OUTPUT TABLE	
001	014S6001;	WOC		
002	014S6002;	WOC		
003	014S6023;	WOC		
004	014S6004;	WOC		
005	014S6025;	WOC		
006	014S6026;	WOC		
007	014S6007;	WOC		
010	014S6010;	WOC		
011	014S6031;	WOC		
012	014S6020;	WOC		
013	014S6037;	WOC		
014	000S3700;	TRU		STORE ARGUMENTS & GO INITIALIZE
015	305S7100;	MCL		
016	010 1200;	STB		
017	011 1000;	STC	START COMP.	
020	222S3705;	TRU		
021	007 0500;	LDA	DETERMINE SIGN, COMPLEMENT & SET PRINT SIGN	
022	032 3505;	TAN		
023	012 1100;	STA		
024	046 0505;	LDA		
025	031 1105;	STA		
026	051 0405;	LDC		
027	050 0505;	STC		
030	052S3705;	TRU		
031	000S3705;	TRU		
032	000 4500;	CLA		
033	007 1500;	SUB		
034	040 7505;	TOF		
035	012 1100;	STA		

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PROBLEM DECIMAL OUTPUT SUBROUTINE, I, APPENDIX B

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PROGRAMMER P. JARVIE

DATE 2-28-61

LOCATION	INSTRUCTION	SYMBOLIC OF CODE	REMARKS
036	047 0505;	LDA	ADJUST X & Q SINCE # = -1@ 0
037	025S3705;	TRU	
040	007 0500;	LDA	
041	013 0400;	LDC	
042	044 2200;	RSI	
043	007 1100;	STA	
044	013 1000;	STC	
045	032S3705;	TRU	
046	012S3705;	TRU	
047	013S3705;	TRU	
050	055S3705;	TRU	PROGRAM CONSTANTS
051	+0003232		
052	014 1105;	STA	TRANSFORM $x$ TO $\tilde{x}$ , DECIMALLY SCALED INTEGER & ROUNDED
053	053 7737;	TES	
054	031S3705;	TRU	
055	014 0600;	LDB	
056	012 0400;	LDC	
057	106 3200;	MUP	
060	061 2100;	LSD	
061	062S1605;	DPA	
062	-0000000		
063	+0000000		
064	210S3705;	TRU	TEMP FOR COUNTER
065	016 0500;	LDA	REDUCE COUNTER
066	067S1105;	STA	
067	+0000000		
070	067 0405;	LDC	
071	073 2100;	LSD	
072	115 3405;	TCN	
073	067 1005;	STC	

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LOCATION	INSTRUCTION	SYMBOLIC OP CODE	REMARKS
074	000 4500;	CLA	COMPUTE DIGITS
075	015 0600;	LDB	
076	100 2100;	LSD	
077	271 0405;	LDC	
100	000 2400;	NOP	
101	130 3100;	DIV	
102	015 1200;	STB	
103	105 2200;	RSI	
104	113 3505;	TAN	
105	000 1100;	STA	
106	105 0505;	LDA	
107	110S1505;	SUB	ADJUST DIGIT ( REMAINDER )
110	001 0000;		
111	105 1105;	STA	
112	070S3705;	TRU	INITIALIZE COUNTER
113	271 1405;	ADD	
114	105S3705;	TRU	STORE DIGIT TEMP.
115	000 4500;	CLA	
116	067 1105;	STA	
117	000 0500;	LDA	COMPLETE INIT.
120	121S1105;	STA	
121	+0000000		DELETE FLAG
122	126S3705;	TRU	
123	125 1105;	STA	PRINT OR EXIT
124	021S3705;	TRU	
125	+0000000		
126	067 0505;	LDA	
127	017 5600;	CAM	
130	176 7505;	TOF	
131	016 5600;	CAM	

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PROBLEM DECIMAL OUTPUT SUBROUTINE I, APPENDIX B

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PROGRAMMER P. JARVIE

DATE 2-28-61

LOCATION	INSTRUCTION	SYMBOLIC OF CODE	REMARKS	
132	011 7500;	TOF	PRINT DIGIT	
133	121 0505;	LDA		
134	135S5605;	CAM		
135	+0000000	"0"		
136	140 7505;	TOF		
137	147S3705;	TRU		
140	125 0505;	LDA		
141	137 3505;	TAN		
142	217S3705;	TRU		PRINT SPACE
143	117 0505;	LDA		BUMP DIGIT SECT.
144	110 1405;	ADD		
145	117 1105;	STA		
146	117S3705;	TRU		PRINT DIGIT
147	142 0505;	LDA		
150	125 1105;	STA		
151	152S0505;	LDA		COMMON PRINT SEQUENCE
152	172S3705;	TRU		
153	014 1105;	STA		
154	121 0505;	LDA		
155	000 4300;	CLB		
156	175 2100;	LSD		
157	160S1405;	ADD		
160	000S3705;	TRU		
161	171 1105;	STA		
162	163S0405;	LDC		
163	-7777777			
164	166 2200;	RSI		
165	164 3405;	TCN		
166	166 7737;	TES		
167	170S0405;	LDC		

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PROBLEM DECIMAL OUTPUT SUBROUTINE I, APPENDIX B

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PROGRAMMER P. JARVIE

DATE 2-28-61

LOCATION	INSTRUCTION	SYMBOLIC OP CODE	REMARKS
170	+0003232		BUMP COUNTER
171	000S3705;	TRU	
172	067 0405;	LDC	
173	175 2200;	RSI	
174	067 1005;	STC	
175	143S3705;	TRU	
176	163 0405;	LDC	
177	201 2200;	RSI	
200	177 3405;	TCN	
201	201 7737;	TES	
202	170 0405;	LDC	
203	000 6113;	WOC	
204	142 0505;	LDA	
205	125 1105;	STA	
206	067 0505;	LDA	
207	131S3705;	TRU	
210	015 1100;	STA	
211	063 5605;	CAM	
212	214 7505;	TOF	TO CHECK IF $\tilde{x} = 0$
213	065S3705;	TRU	
214	142 0505;	LDA	
215	125 1105;	STA	
216	065S3705;	TRU	PRINT SPACE
217	271 0505;	LDA	
220	121 1105;	STA	
221	151S3705;	TRU	
222	224 2100;	LSD	
223	000 4500;	CLA	
224	233 2100;	LSD	
225	013 1100;	STA	



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LOCATION	INSTRUCTION	SYMBOLIC OF CODE	REMARKS
226	000 4500;	CIA	INITIALIZE
227	236 2100;	LSD	
230	017 1100;	STA	
231	000 4500;	CLA	
232	241 2100;	LSD	
233	017 1400;	ADD	
234	216 1100;	STA	
235	017 1500;	SUB	
236	255 2100;	LSD	
237	240S1405;	ADD	
240	270 0505;	LDA	
241	242 1105;	STA	
242	270 0505;	LDA	
243	014 1100;	STA	
244	277S3705;	TRU	
245	264 2100;	LSD	
246	247S1405;	ADD	
247	061 2100;	LSD	
250	060 1105;	STA	
251	016 0400;	LDC	
252	254 2100;	LSD	
253	011 3400;	TCN	
254	000 0100;	IAC	
255	274 2100;	LSD	
256	257S1405;	ADD	
25705\$	000 1100;	STA	
260	105 1105;	STA	
261	262S0505;	LDA	
262	000 0500;	LDA	
263	117 1105;	STA	

