

RECOMP II USERS' PROGRAM NO. 1060

PROGRAM TITLE: MODIFIED BESSEL FUNCTION OF THE FIRST KIND  
 $I_1(x)$ , FLOATING POINT (RELOCATABLE)

PROGRAM CLASSIFICATION: General

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PURPOSE: To compute in floating point the modified  
Bessel function  $I_1(x)$ .

DATE: 13 February 1961

Published by

RECOMP Users' Library

at

AUTONETICS INDUSTRIAL PRODUCTS

A DIVISION OF NORTH AMERICAN AVIATION, INC.  
3400 E. 70th Street, Long Beach 5, Calif.

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Program Title: Modified Bessel Function of the First Kind  $I_1(x)$ , Floating Point (Relocatable).

1. PURPOSE

1.1 To compute in floating point the modified Bessel function  $I_1(x)$ .

2. RESTRICTIONS

2.1 Require AN-044 exponential subroutine.

2.2 Argument must be a positive number.

3. METHOD

3.1 Truncated power series or exponential approximation, depending on size of argument.

3.1.1  $x < 7$   $I_1(x) \approx \frac{x}{2} + \sum_{k=1}^7 \frac{1}{k} \left(\frac{x}{2}\right)^{2k+1}$

3.1.2  $x \geq 7$   $I_1(x) \approx \frac{e^x}{\sqrt{2\pi x}} \left(1 - \sum_{k=1}^3 \frac{M_k}{(8x)^k}\right)$

3.2 Accuracy within  $\pm 0.01\%$

3.3 Reference

H. B. Dwight, Tables of Integrals and Other Mathematical Data, MacMillan Co., 1947, Equations 813.2 and 814.2

4. USAGE

4.1 The argument must be in the A and R registers as a normalized floating point number. The result is left in the A and R registers upon exiting.

4.2 Calling sequence

4.2.1 If AN-044 is located at ( $I_1 + 150.0$ )

TRA  $I_1$

Return

4.2.2 If AN-044 is elsewhere in memory

SLL

-----  
 TRA ( $I_1 + 140.0$ ) (octal)

PZE EXP

-----  
 Return

$\alpha$

$\alpha + 1$

-2-

EXP is the first location of AN-044

$I_1$  is first location of  $I_1$  routine.

After you have used 4.2.2 on a run the program can now be entered by 4.2.1

4.3 Use location 0000 to 0144 relocatable

Temporary storage 0134 to 0137

4.4 Error Codes

If the limits of AN-044 are exceeded there will be a halt and transfer to ( $I_1 + 0044.1$ ).

If you press start you will return to the main program.

4.5 Both L and V loops are used by this routine.

4. Coding Information

5.1 Constants (floating point)

	0100	7.0
	0102	1.0
$C_1$	0104	2.0
$2\pi$	0106	6.283185308
$C_2$	0110	12.0
$C_3$	0112	144.0
$C_4$	0114	2880.0
$C_5$	0116	86400.0
$C_6$	0120	3628800.0
$C_7$	0122	203212800.0
$M_1$	0124	3.0
$M_2$	0126	7.5
$M_3$	0130	52.5
	0132	8.0

0000.0 +15.0076.0 SAX  
+01.0075.0 ADD

0001.0 +42.0044.1 STA  
+43.0000.0 XAR

0002.0 +60.0077.0 STO  
+30.0076.0 FCA

0003.0 +06.0100.0 FSB  
+52.0045.0 TRP

0004.0 +64.0010.0 CTL  
+66.0020.0 CTV

0005.0 +30.0076.0 FCA  
+05.0104.0 EDV

0006.0 +35.7772.0 FST  
+07.7772.0 FMP

0007.0 +35.7776.0 FST  
+57.7760.0 TRA

0010.0 +07.7772.0 FMP  
+35.7774.0 FST

0011.0 +05.0104.0 FDV  
+04.7772.0 FAD

0012.0 +35.7772.0 FST  
+30.7776.0 FCA

0013.0 +07.7774.0 FMP  
+35.7774.0 FST

0014.0 +05.0110.0 FDV  
+04.7772.0 FAD

0015.0 +35.7772.0 FST  
+30.7776.0 FCA

0016.0 +07.7774.0 FMP  
+35.7774.0 FST

0017.0 +05.0112.0 FDV  
+04.7772.0 FAD

0020.0 +35.7772.0 FST  
+30.7776.0 FCA

0021.0 +64.0030.0 CTL  
+57.7760.0 TRA

0022.0 +00.0000.0 ---  
-00.0000.0 ---

0023.0 +00.0000.0 ---  
-00.0000.0 ---

0024.0 +00.0000.0 ---  
-00.0000.0 ---

0025.0 +00.0000.0 ---  
-00.0000.0 ---

0026.0 +00.0000.0 ---  
-00.0000.0 ---

0027.0 +00.0000.0 ---  
-00.0000.0 ---

0030.0 +07.7774.0 EMP  
+35.7774.0 FST

0031.0 +05.0114.0 FDV  
+04.7772.0 EAD

0032.0 +35.7772.0 EST  
+30.7776.0 FCA

0033.0 +07.7774.0 FMP  
+35.7774.0 EST

0034.0 +05.0116.0 EDV  
+04.7772.0 FAD

0035.0 +35.7772.0 FST  
+30.7776.0 FCA

0036.0 +07.7774.0 FMP  
+35.7774.0 FST

0037.0 +64.0040.0 CTL  
+57.7760.0 TRA

0040.0 +05.0120.0 FDV  
+04.7772.0 FAD

0041.0 +35.7772.0 FST  
+30.7776.0 FCA

0042.0 +07.7774.0 FMP  
+35.7774.0 FST

0043.0 +05.0122.0 FDV  
+04.7772.0 FAD

0044.0 +35.7770.0 EST  
+57.0000.0 TRA

0045.0 +30.0076.0 FCA  
+57.0300.0 TRA

0046.0 +00.7774.0 CLA  
+77.0044.1 HTR

0047.0 +64.0050.0 CTL  
+57.7760.0 TRA

0050.0 +66.0060.0 GTV  
+35.7776.0 FST

0051.0 +30.0106.0 FCA  
+07.0076.0 FMP

0052.0 +35.7774.0 FST  
+44.7774.0 FSQ

0053.0 +35.7774.0 FST  
+30.7776.0 FCA

0054.0 +05.7774.0 EDV  
+35.0134.0 FST

0055.0 +30.0102.0 FCA  
+05.0132.0 FDV

0056.0 +05.0076.0 FDV  
+35.7774.0 FST

0057.0 +07.0124.0 FMP  
+35.7776.0 FST

0060.0 +30.7774.0 ECA  
+07.7774.0 FMP

0061.0 +35.0136.0 FST  
+07.0126.0 FMP

0062.0 +04.7776.0 FAD  
+35.7776.0 FST

0063.0 +64.0070.0 CTL  
+57.7760.0 TRA

0064.0 +00.0000.0 ---  
-00.0000.0 ---

0065.0 +00.0000.0 ---  
-00.0000.0 ---

0066.0 +00.0000.0 ---  
-00.0000.0 ---

0067.0 +00.0000.0 ---  
-00.0000.0 ---

0070.0 +30.0136.0 FCA  
+07.7774.0 FMP

0071.0 +07.0130.0 FMP  
+04.7776.0 FAD

0072.0 +35.7776.0 FST  
+30.0102.0 FCA

0073.0 +06.7776.0 FSB  
+07.0134.0 FMP

0074.0 +57.0044.1 TRA  
+00.0000.0 CLA

0075.0 +00.0000.0 ---  
-00.0000.1 ---

0076.0 +00.0000.0 ---  
-00.0000.0 ---

0077.0 +00.0000.0 ---  
-00.0000.0 ---

0100.0 +70.0000.0 ---  
-00.0000.0 ---

0101.0 +00.0000.0 ---  
-00.0001.1 ---

0102.0 +40.0000.0 ARS  
-00.0000.0 ---

0103.0 +00.0000.0 ---  
-00.0000.1 ---

0104.0 +40.0000.0 ARS  
-00.0000.0 ---

0105.0 +00.0000.0 ---  
-00.0001.0 ---

0106.0 +62.2077.0 ---  
+52.4240.0 TRP

0107.0 +00.0000.0 ---  
-00.0001.1 ---

0110.0 +60.0000.0 STO  
-00.0000.0 ---

0111.0 +00.0000.0 ---  
-00.0002.0 ---

0112.0 +44.0000.0 FSQ  
-00.0000.0 ---

0113.0 +00.0000.0 ---  
-00.0004.0 ---

0114.0 +55.0000.0 TSC  
-00.0000.0 ---

0115.0 +00.0000.0 ---  
-00.0006.0 ---

0116.0 +52.1400.0 TRP  
-00.0000.0 ---

0117.0 +00.0000.0 ---  
-00.0010.1 ---

0120.0 +67.2760.0 CFV  
-00.0000.0 ---

Page 7  
M-105b  
13 February 1961

0121.0 +00.0000.0 ---  
-00.0013.0 ---

0122.0 +60.3462.0 STO  
-00.0000.0 ---

0123.0 +00.0000.0 ---  
-00.0016.0 ---

0124.0 +60.0000.0 STO  
-00.0000.0 ---

0125.0 +00.0000.0 ---  
-00.0001.0 ---

0126.0 +74.0000.0 PNC  
-00.0000.0 ---

0127.0 +00.0000.0 ---  
-00.0001.1 ---

0130.0 +64.4000.0 CTL  
-00.0000.0 ---

0131.0 +00.0000.0 ---  
-00.0003.0 ---

0132.0 +40.0000.0 ARS  
-00.0000.0 ---

0133.0 +00.0000.0 ---  
-00.0002.0 ---

0134.0 +00.0000.0 ---  
-00.0000.0 ---

0135.0 +00.0000.0 ---  
-00.0000.0 ---

0136.0 +00.0000.0 ---  
-00.0000.0 ---

0137.0 +00.0000.0 ---  
-00.0000.0 ---

0140.0 +15.0076.0 SAX  
+42.0142.1 STA

0141.0 +01.0144.0 ADD  
+42.0044.1 STA

0142.0 +40.0000.0 ARS  
+00.0000.0 CLA

0143.0 +42.0045.1 STA  
+57.0001.1 TRA

0144.0 +00.0000.0 ---  
-00.0001.0 ---