

IDENTIFICATION: MACH NO. vs Q/P (Single Precision)

AUTHOR: LCDR. R. D. Witty

ACCEPTED: January 7, 1963

SPACE: This routine is written for operation in line 07. 153 non-consecutive sectors of a long line and sectors 1, 4 and 15 of line zero are used by the routine.

TIMING:

0.1 Mach	0.96	5.58 Mil.
0.96 Mach	1.53	3.096 Mil.
1.53 Mach	3.11	2.7 Mil.

ACCURACY: Maximum error in Mach No. will be less than $5 \cdot 10^{-4}$ as computed from NASA TN D-822 of August, 1961.

RESTRICTIONS: The Mach No. range of the routine is $0.1 \leq M \leq 3.11$

CALLING SEQUENCE:

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MLX Routine to line 07
LDA Q/P @ 4
LDC Return
TRU 00007$
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Exit is accomplished with M @ 2 in the A Register.

METHOD: Three equations are used by this routine. Two rational expressions for the supersonic values and a polynomial expression for the subsonic values.

For $M < 0.96$

$$M = \left[5 \sum_{i=1}^{11} A_i X^i \right]^{\frac{1}{2}}$$

METHOD (Cont'd)

A ₁	=	0.2857	1428	57
A ₂	=	-0.1020	4081	63
A ₃	=	0.0583	0903	79
A ₄	=	-0.0395	6684	71
A ₅	=	0.0293	9251	50
A ₆	=	-0.0230	9411	89
A ₇	=	0.0188	5234	20
A ₈	=	-0.0158	2250	13
A ₉	=	0.0135	6214	40
A ₁₀	=	-0.0118	1843	98
A ₁₁	=	0.0049	8201	21

For $0.96 \leq M < 1.53$

$$M = \frac{A_1 X^2 + A_2 X + A_3}{A_4 X^3 + A_5 X^2 + A_6 X + A_7}$$

A ₁	=	0.5344	4544	54
A ₂	=	0.6140	9792	80
A ₃	=	-0.9887	1329	00
A ₄	=	-0.0011	7599	25
A ₅	=	0.1025	5969	56
A ₆	=	1.3236	5982	00
A ₇	=	-0.7758	7550	00

For $1.53 < M \leq 3.11$

$$M = \frac{A_1 X^2 + A_2 X + A_3}{A_4 X^3 + A_5 X^2 + A_6 X + A_7}$$

A ₁	=	0.5337	9939	60
A ₂	=	0.6204	1088	00
A ₃	=	-0.9989	0680	00
A ₄	=	0.0011	7599	25
A ₅	=	0.1025	5969	56
A ₆	=	1.3236	5982	00
A ₇	=	-0.7758	7550	00

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LOCATION	INSTRUCTION	SYMBOLIC			REMARKS
		LOCATION	OP	ADDRESS	
00007\$	001S1000;		STC		Exit to F ₀₁
002	003S4400;		CLC		
004	005S0000;		MAC		Q/P @ 4 to (C)
006	007S1507;		SUB		(Q/P - 0.80776) @ 4 to (a)
010	012 3507;		TAN		
011	020S0100;		IAC		Q/P @ 4 to (A)
021	030S1407;		ADD		P _t /P @ 4 to (a)
031	032S4400;		CLC		
033	034S0000;		MAC		P _t /P @ 4 to (C)
035	036S1507;		SUB		(P _t /P - 3.52791) @ 4 to (A)
037	041 3507;		TAN		
040	042S0607;		LDB		A ₄ @ -6 to (B)
043	072S3200;		MUP		
072	075S1407;		ADD		(A ₄ X + A ₅) @ -2 to (A)
076	077S0100;		IAC		
100	101S0300;		ROT		
103	132S3200;		MUP		(A ₄ X ² + A ₅ X) @ 2 to (AB)
132	133S1407;		ADD		(A ₄ X ² + A ₅ X + A ₆) @ 2 to (A)
134	135S0100;		IAC		
136	137S0300;		ROT		
141	170S3200;		MUP		
170	172S2110;		SLT		
172	173S1507;		SUB		(A ₄ X ³ + A ₅ X ² + A ₆ X + A ₇) @ 5
174	175S1100;		STA		Divisor to F ₁₅
176	177S0607;		LDB		A ₁ @ Zero
200	227S3200;		MUP		

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LOCATION	INSTRUCTION	SYMBOLIC			REMARKS
		LOCATION	OP	ADDRESS	
227	231S2110;		SLT		
231	232S1407;		ADD		(A ₁ X + A ₂) @ 3 to (A)
233	234S0100;		IAC		
235	236S0300;		ROT		
240	267S3200;		MUP		
267	270S1707;		DPS		(A ₁ X ² + A ₂ X + A ₃) @
27207\$	275S0400;		LDC		Divisor to (C)
276	325S3100;		DIV		Mach @ 2 to (B)
325	326S0300;		ROT		
330	341S3700;		TRU		
					0.96 ≤ Mach < 1.53
00007\$	001S1000;		STC		Exit to F ₀₁
002	003S4400;		CLC		
004	005S0000;		MAC		Q/P @ 4 to (C)
006	007S1507;		SUB		(Q/P - 0.80776) @ 4 to (a)
010	012 3507;		TAN		
011	020S0100;		IAC		A/P @ 4 to (A)
021	030S1407;		ADD		P _t /P @ 4 to (A)
031	032S4400;		CLC		
033	034S0000;		MAC		P _t /P @ 4 to (C)
035	036S1507;		SUB		(P _t /P - 3.52791) @ 4 to (A)
037	041 3507;		TAN		
041	043S0100;		IAC		P _t /P @ 4 to (A)
044	047S2110;		SLT		P _t /P @ 2 to (A)
047	050S0100;		IAC		
051	052S0607;		LDB		A ₄ @ -9

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LOCATION	INSTRUCTION	SYMBOLIC			REMARKS
		LOCATION	OP	ADDRESS	
05307\$	102S3200;		MUP		
102	107S2210;		SRT		$A_4 X @ -3$
107	110S1407;		ADD		$A_4 X + A_3$
111	112S0100;		IAC		
113	117S0300;		ROT		
121	150S3200;		MUP		
150	153S2210;		SRT		
153	161S1407;		ADD		$(A_4 X^2 + A_3 X + A_2) @ 1 \text{ to } (A)$
162	163S0100;		IAC		
164	167S0300;		ROT		
171	220S3200;		MUP		
220	222S1507;		SUB		$(A_4 X^3 + A_3 X^2 + A_2 X + A_1) @ 3 \text{ to } (A)$
223	224S1100;		STA		Divisor @ 3 to F04
225	236S0607;		LDB		$A_1 @ \text{Zero}$
237	266S3200;		MUP		
266	273S1407;		ADD		$(A_1 X + A_2) @ 2$
274	276S0100;		IAC		
277	300S0300;		ROT		
302	331S3200;		MUP		
331	332S1707;		DPS		$(A_1 X^2 + A_2 X + A_3) @ 4$
334	336S2210;		SRT		Numerator @ 5 to (AB)
336	344S0400;		LDC		Divisor @ 3 to (C)
345	374S3100;		DIV		Mach @ 2 to (b)
374	375S0300;		ROT		Mach No. @ 2 to (A)
377	001S3700;		TRU		EXIT
					$0.1 \leq \text{Mach} < 0.96$

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LOCATION	INSTRUCTION	SYMBOLIC			REMARKS
		LOCATION	OP	ADDRESS	
00007\$	001S1000;		STC		Exit to F01
002	003S4400;		CLC		
004	005S0000;		MAC		Q/P @ 4 to (C)
006	007S1507;		SUB		(Q/P - 0.80776) @ 4 to (A)
010	012 3507;		TAN		
012	013S0100;		IAC		Q/P @ 4 to (A)
014	015S4300;		CLB		
016	023S2110;		SLT		Q/P @ Zero
023	024S0100;		IAC		
025	026S0607;		LDB		A ₁₁ @ -6
027	056S3200;		MUP		
056	057S1507;		SUB		A ₁₁ X + A ₁₀ @ -6
060	061S0100;		IAC		
062	063S0300;		ROT		
065	114S3200;		MUP		
114	115S1407;		ADD		A ₉ + . . . + A ₁₁ X ² @ -6
116	117S0100;		IAC		
120	121S0300;		ROT		
123	152S3200;		MUP		
152	154S2210;		SRT		
154	155S1507;		SUB		A ₈ + . . . + A ₁₁ X ³ @ -5
156	157S0100;		IAC		
160	161S0300;		ROT		
163	212S3200;		MUP		
212	213S1407;		ADD		A ₇ + . . . + A ₁₁ X ⁴ @ -5
214	215S0100;		IAC		

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		LOCATION	OP	ADDRESS	
21607\$	217S0300;		ROT		
221	250S3200;		MUP		
250	251S1507;		SUB		$A_6 + \dots + A_{11}X^5 @ -5$
252	253S0100;		IAC		
254	255S0300;		ROT		
257	306S3200;		MUP		
306	307S1407;		ADD		$A_5 + \dots + A_{11}X^6 @ -5$
310	311S0100;		IAC		
312	313S0300;		ROT		
315	344S3200;		MUP		
344	346S2210;		SRT		
346	347S1507;		SUB		$A_4 + \dots + A_{11}X^7 @ -4$
350	351S0100;		IAC		
352	362S0300;		ROT		
364	013S3200;		MUP		
013	017S1407;		ADD		$A_3 + \dots + A_{11}X^8 @ -4$
020	021S0100;		IAC		
022	030S0300;		ROT		
032	061S3200;		MUP		
061	063S2210;		SRT		
063	066S1507;		SUB		$A_2 + \dots + A_{11}X^9 @ -3$
067	070S0100;		IAC		
071	075S0300;		ROT		
077	126S3200;		MUP		
126	131S2210;		SRT		
131	137S1407;		ADD		$A_1 + \dots + A_{11}X^{10} @ -1$

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LOCATION	INSTRUCTION	SYMBOLIC			REMARKS
		LOCATION	OP	ADDRESS	
14007\$	141S0100;		IAC		$A_1 X + \dots + A_{11} X^{11} @ -1 \text{ to } (C)$ <p>5 @ 3 to (B)</p> <p>M @ 1 to (B)</p> <p>To Exit with M @ 2 in (A)</p>
142	144S0300;		ROT		
146	175S3200;		MUP		
175	200S0100;		IAC		
201	204S0607;		LDB		
205	234S3200;		MUP		
234	262S3030;		SQR		
262	277S0300;		ROT		
301	303S2210;		SRT		
303	321S3700;		TRU		