TRW-130 *AN/UYK-1*
DATA PROCESSING SYSTEM

SOFTWARE SUPPORT

TRW-130 (AN/UYK-1) SOFTWARE CATALOG

M250-2U18 REV APR 1963

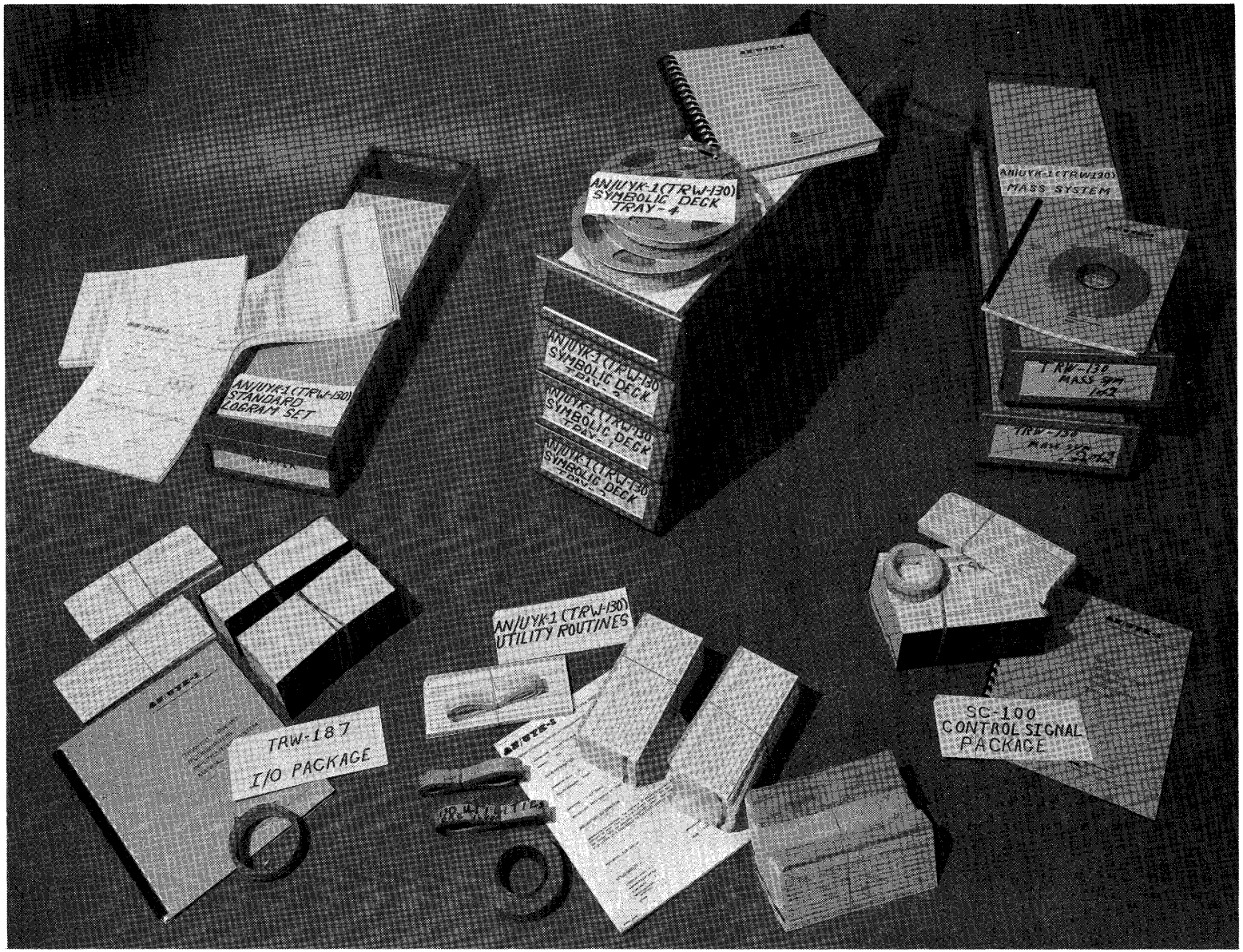
TRW COMPUTER DIVISION
THOMPSON RAMO WOOLDRIDGE INC.
8433 Fallbrook Avenue • Canoga Park, California

FOREWORD

The TRW-130 (AN/UYK-1) Software Library Catalog is a comprehensive bibliography of the documentation pertinent to the TRW-130 Digital Computer. Pertinent documents include those concerning any peripheral devices used with the computer and the problem applications for which the computer may be used.

The TRW-130 is a multiple-purpose computer. As such it is potentially dynamic, both in application technologies and hardware techniques.

As they evolve, new uses and methods are documented. Improved and alternate lograms are an important part of TRW's effort to help TRW-130 users achieve maximum computer utilization. Revisions are indicated by the Library numbering codes.



Typical AN/UYK-1 (TRW-130) Software Library Items

TRW SOFTWARE SUPPORT

TRW-130 (AN/UYK-1) SOFTWARE CATALOG

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TRW Software Support

TRW-130 (AN/UYK-1) SOFTWARE CATALOG

The documents and software items available to TRW-130 computer users are listed in this catalog. The library classification follows precepts set by the Association for Computing Machinery.

EXPANDING OR MODIFYING COMPUTER USAGE

The TRW-130 Software Library Catalog is of special interest to the user who wishes to augment or modify his computer program or to expand his existing system.

The Basic Logram Set furnished with each system is a powerful and useful means of adapting the computer to many varied types of problems. It includes basic problem-step solutions for relatively simple operations (Add, Multiply, etc.) and for more complex operations such as Extract Square Root, and trigonometric functions (e.g. sine, cosine). An Optional Arithmetic Set, described in Section L, and instruction sequences from the Additional Logram Set are programming aids readily available to TRW-130 users. A growing number of programs are also available from the library.

An existing program may be augmented or modified by several means, depending upon the direction and degree of complexity of the problem:

1. Logrames existing in the library can be combined to form interpretive programs.
2. The desired program may be compiled, tested and made available from the Software Library.
3. New logrames may be written by the user's own programming staff.

The Application Studies may suggest useful programming technologies. The multiple-purpose character of the TRW-130 allows a wide range of computing processes. Consequently, new program applications are being continually developed and implemented. In addition to the studies conducted by TRW research programmers, projects developed and contributed by TRW-130 users will be available subject to security restrictions and availability of copies.

SOFTWARE SUPPORT

The fundamental software needed to operate the computing system includes the programming reference manuals, a Basic Logram Set, and routines for the assembler, diagnostics and input/output.

The Basic Software Package is carried as a single library item for the Standard, or minimal, TRW-130 configuration, which includes:

TRW-130 Computer
TRW-140 Controller
TRW-151 Paper Tape Reader
TRW-161 Paper Tape Punch
TRW-185 Input/Output Typewriter

For other configurations, software appropriate to the installation is delivered with each TRW-130 computing system.

1ZAA1110 BASIC SOFTWARE PACKAGE

AN/UYK-1 (v) DIGITAL COMPUTER SET TECHNICAL MANUALS (2 each)		
VOLUME I	COMPUTER Technical Manual for AN/UYK-1 (TRW-130) Digital Computer	M250-2U1
VOLUME II	CONTROLLER Technical Manual for TRW-140 Controller	M250-2U3
VOLUME III	PROGRAMMING AN/UYK-1 (TRW-130) Machine Reference Manual	M250-2U19
	TRW-140 Input/Output Controller Reference Manual	M250-2U27
	System Diagnostics Manual (Diagnostic tape 1 each (Reels 1 and 2)	M250-2U24
BASIC LOGRAM SET (1 each)		M250-2U21
	Manual with general description, listings, and cover sheets for each logram. Punched paper tape of Basic Logram Set	
PROGRAM ASSEMBLER (1 each)		M250-2U20
	General description, operating instructions, and sample listings from high and low core for both 8 and 5 level tapes. Punched paper tape of Assembler Program	
GENERAL PURPOSE I/O ROUTINES (1 each)		M250-2U22
	Programming procedures, how to use routines, and listings. Punched paper tapes for loading through the reader. Punched paper tapes for Typewriter and Punch routines, both In and Out.	

ORDERING LIBRARY ITEMS

Library items may be ordered by addressing a request, giving library number and title, to

Thompson Ramo Wooldridge, Inc.
TRW-130 Software Library
8433 Fallbrook Avenue Phone (213) 346-6000, Ext. 2052
Canoga Park, California

One (1) each library item* (which is not furnished with initial installation) will be sent free of charge. Additional items will be priced upon request.

PROGRAMMING ASSISTANCE

Programming assistance during peak workload periods, or for program or system modification, is available from Thompson Ramo Wooldridge, Inc. programming staffs at West Coast and East Coast offices. The computer owner planning to augment or modify his existing computer program or system should consult a TRW sales representative.

REPLACEABLE PARTS LIST

A replaceable parts list, separate from that provided as an integral part of the maintenance manuals, is available on request.

The list, in spare parts provisioning document format, is an indentured breakdown of all TRW-manufactured electronic components for the TRW-130 system, showing the relationship of each part to its next higher assembly. All basic provisioning data, such as part numbers, item name, Federal Manufacturers Code, population data, budgetary unit prices, etc., are included in the list. It does not, however, include recommended spares quantities for particular combinations or quantities of TRW-130 units. One Ozalid copy of the list will be provided each customer at no charge. Additional copies can be furnished at a cost of $25.00. Reproducible copies can be furnished at a cost of $90.00.

TRW can furnish spare parts lists prepared to a particular provisioning specification, or adapt the above replaceable parts list to specific combinations or quantities of TRW series units. Prices for this service are subject to negotiation.

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*Lograms and programs are normally furnished on Punched Tape Mylar Blue Sandwich (5-level) TRW Spec 400951. Special arrangements must be made for other media.

LIBRARY CONTENT AND INDEXING SYSTEM

TRW Software Library items are cataloged on punched cards. The leading entry is an 8-digit code representing the catalog number, which is based on a version of the Dewey Decimal cataloging system.

The leading figure "1" in the catalog number designates the Standard TRW-130 (AN/UYK-1) System. The Software types cataloged are:

H	Technical Manuals, Software
L	Lograms*
P	Programs*
S	Application Studies

Each software type is further identified by Class and Sub-Class, as described in the pages preceding the listing of each type. The last four digits of the catalog number represent Library Serial Number and Revision Number, which are assigned by the software librarian.

EXAMPLE:

Computer System and Configuration	Document Type	Class	Sub-Class	Library Serial Number	Revision Number
1	L	E	G	100	1
TRW-130 (normal)	Logram	Branch-Unconditional		Serial No.	Revision 1

An understanding of the catalog numbering and delineation scheme will assist the user in choosing materials from the library, devising a compatible system for his own facility, and submitting results of his own developments to the TRW user's exchange.

*Available as punched card decks, punched paper tape (also on magnetic tape in some cases).

H

TECHNICAL MANUALS - SOFTWARE

Serial Number		
1HAA1010	TRW-130 (AN/UYK-1) MACHINE REFERENCE MANUAL*	M250-2U19 Feb 1963
	Detailed manual relating the logical command structure and organization for TRW-130 (AN/UYK-1) programming to the wired control logic inherent in machine operation. A standard manual for training logrammers.	
1HAB1140	TRW-130 (AN/UYK-1) BASIC LOGRAM PACKAGE*	M250-2U21
	General description of the Basic Logram set, cover sheets for each individual logram, and listings of the basic logram package.	
1HAB1150	TRW-130 (AN/UYK-1) GENERAL PURPOSE INPUT/OUTPUT ROUTINES*	M250-2U22
	Program procedures, how to use routines, and listings.	
1HAA1130	TRW-140 INPUT/OUTPUT CONTROLLER REFERENCE MANUAL*	M250-2U27
	Functional description of TRW-140 Controller used as a switching and transfer device between the AN/UYK-1 Digital Computer and one, several, or all of these peripheral devices: TRW-151 Paper Tape Reader and Reeler, TRW-161 Paper Tape Punch, TRW-185 I/O Typewriter, TRW-186 Send/Receive Set and IBM 024 or 026 Card Reader/Punch.	
1HBA1170	TRW-130 (AN/UYK-1) SYSTEM DIAGNOSTICS MANUAL*	M250-2U24
	Functional description of comprehensive diagnostic programs used to test computer hardware and circuitry, by exercising selected portions, individual tests or combinations of tests. Includes flow diagrams and assembly listing.	
1HLA1080	PROGRAM ASSEMBLER FOR PAPER TAPE SYSTEM	M250-2U20
	Instructions and theory of on-hardware operation of the logram/logand assembler. This program loads the memory portion of TRW-130 (AN/UYK-1) computer, using paper tape input to the TRW-130.	

*Included in Basic Software Package.

1HAA1020 A PROGRAMMER'S GUIDE M250-2U5

Guide to programming the TRW-130 in symbolic program-oriented language. Describes preparation of operational programs by means of writing calling sequences, utilizing TRW Basic Logram Package.

1HLA0920 MONITOR, ASSEMBLER, SIMULATOR SYSTEM - (MASS) M250-2U33

Instructions and theory of operation for simulation, monitoring, assembly and execution of TRW-130 (AN/UYK-1) programs on IBM 7090. Simulated MASS programs are TRW-130 compatible.

1HAB1160 TRW-187 (FLEXOWRITER) INPUT/OUTPUT SYSTEM MANUAL M250-2U28

Functional description of programming and operating requirements for use of TRW-187 Flexowriter as an input device with the TRW-130 (AN/UYK-1).

1HAA0990 TRW-195 (SC-100) CONTROL SIGNAL CONVERTER PROGRAMMING MANUAL M250-2U29

Programming instructions for TRW-195 (SC-100) acting as a buffer for communication between two TRW-130 (AN/UYK-1) computers, or between a TRW-130 and AN/USQ-20 Computer. Listings of Diagnostic routines for Control Signal Converter included.

1GCC1750 TRW-193/170 MAGNETIC TAPE SYSTEM REFERENCE MANUAL M250-2U44

Functional description and operating requirements of TRW-170 Magnetic Tape units and TRW-192 Magnetic Tape Controller used with the TRW-130 Digital Computer.

L

LOGRAMS

Full benefit of TRW Stored Logic is realized through appropriate use of TRW-130 Lograms. The operation to be performed by a logram may be as simple (and as rapidly performed) as a single instruction in a single or multiple-address computer; conversely, a logram may be as complex as a subroutine in a fixed logic system.

Basic Logram Set The Basic Logram Set can be applied to a wide variety of applications. The programming flexibility inherent to the TRW-130 is possible because logram blocks may be linked, and rearranged, to solve many different types of problems.

The Basic Logram Set is normally furnished on Punch Tape Mylar Blue Sandwich (5-level). Other media are available by special arrangement.

ADDITIONAL LOGRAMS

Optional Arithmetic Set An optional arithmetic logram set is available which differs from the arithmetic lograms in the basic set in the treatment of overflow. In the basic set, overflow sets an indicator which the programmer can test; in the optional set, overflow causes transfer of control to an OVNS subroutine (included in the optional set), which in its present form stops the computer. The OVNS subroutine, however, can be tailored by the user to perform any function desired in overflow.

The Optional Arithmetic lograms may be ordered as a package or individually. In both cases, the lograms will be furnished in symbolic card or paper tape form.

Additional Logram Set Additional lograms developed by programming research and user exchange are available from the library. Additional lograms may be ordered in symbolic card or paper tape form.

LOGRAM CALSSIFICATION

Each logram in the library is identified by a classification code, a mnemonic and descriptive title, the number of cells it occupies, etc. Headings are interpreted as follows:

Library Item Code	Data Type	Length	Mnemonic Title	Title	No. of Cells	Execution Time	Parameters Used
1LBC0230	B	1	MP1	Multiply S L	0023	168μs	1

1 — TRW-130
L — Logram
B — Multiply
C — Arithmetic
0230 — Library No.
B — Single Length
1 — Fixed Point Binary

LOGRAM CLASSIFICATION

CLASSIFICATION	Sub-Classification	
A		DATA TRANSFER AND CONVERSION
	A	Load
	B	Store
	C	Move
	D	Copy
	E	Convert
	F	Move and Convert
	G - Y	RESERVED
	Z	Unclassified
B		ARITHMETIC
	A	Add
	B	Subtract
	C	Multiply
	D	Divide
	E	Accumulate
	F	Subtract, Accumulate Difference
	G	Hybrids
	H - Y	RESERVED
	Z	Unclassified
C		ELEMENTARY FUNCTIONS
	A	Square Root
	B	Sine
	C	Cosine
	D	Arcsine
	E	Arctangent
	F - Y	RESERVED
D		SHIFTS (Lograms that shift contents of pseudo-accumulators)
	A	Right
	B	Left — Numeric Open, S L
	C	Right
	D	Left — Numeric Open, D L
	E	Right
	F	Left — Logical Open, S L
	G	Right
	H	Left — Logical Open, D L
	(I not used)	
	J	Right
	K	Left — Locigal Closed, S L
	L	Right
	M	Left — Logical Closed, D L
	M	RESERVED
	(O not used)	
	P	Float Left
	Q	RESERVED
	R	BCD Shift Right and Round S L
	S	BCD Shift Right and Round D L
	T - X	RESERVED
	Y	Special Shifts
	Z	Unclassified

LOGRAM CLASSIFICATION (cont'd)

E BRANCH
- A Hardware Indicator Tests
- B Pseudo-Indicator Tests
- C Single Length Pseudo-Accumulator Tests
- D Double Length Pseudo-Accumulator Tests
- E Compare Single Length Pseudo-Accumulator with Memory
- F Compare Memory with Memory
- G Unconditional Branch
- H Unconditional Branch and Set Return Address to X

(I not used)
- J Special
- K Combinatorial
- L - Y RESERVED
- Z Unclassified

F LOGICAL OPERATIONS
- A Logical AND
- B Inclusive OR
- C Exclusive OR
- D Insert
- E ONE's Complement
- F - Y RESERVED
- Z Unclassified

G MISCELLANEOUS (All logrames that do not fit into any other class)
- (To be defined)

H CONTROL (HARDWARE)
- (To be defined)

I NOT USED

J INPUT
- A TRW-140 Controller
- B TRW-151 Paper Tape Reader (Omnitronics)
- C Not Used
- D Not Used
- E TRW-170 Magnetic Tape Unit
- F TRW-185 Input-Output Typewriter
- G TRW-186 Send/Receive Set (Teletype 028)
- H RESERVED
- I Not Used
- J - Y RESERVED
- Z Unclassified

K OUTPUT
- A TRW-140 Controller
- B Not Used
- C TRW-161 Paper Tape Punch
- D Not Used
- E TRW-170 Magnetic Tape Unit
- F TRW-185 I/O Typewriter
- G TRW-186 Send/Receive Set
- H RESERVED
- I Not Used
- J - Y RESERVED
- Z Unclassified

LOGRAM CLASSIFICATION (cont'd)

DATA TYPE CLASSES

A Alphanumeric
- 1. Single Length Alphanumeric (one word)
- 2. Double (two words)
- 3. Triple (three words)
- 4. Quadruple (four words)
- 5. - 8. Reserved
- 9. Special

B Fixed Point Binary (Signed)
- 1. Single Precision (one word)
- 2. Double (two words)
- 3. Triple (three words)
- 4. Quadruple (four words)
- 5. - 8. Reserved
- 9. Special

C Unassigned

D Binary Coded Decimal (BCD)
(6 bit) (signed)
- 1. Single precision (one word)
- 2. Double
- 3. Triple
- 4. - 8. Reserved
- 9. Special

E Unassigned

F Floating Point Binary
- 1. Single Length
- 2. Double Length
- 3. Triple Length
- 4. - 8. Reserved
- 9. Special

NOTE: Single Precision consists of two words. Word 1 will ALWAYS be the positive exponent. Word 2 will ALWAYS be the most significant portion of the mantissa; less significant parts will continue into other words.

G Unassigned

H Column Binary (TRW-530)
12 bit Hollerith Code and
12 bits read from punched card columns
Variable length data field

I Not Used

J Unassigned

K Unassigned

L Logical Data
One word of unsigned data. May be variable length.

M Not Applicable

O Not Used

P Alphanumeric packed data (continuous 6 bit groups).
Variable length data field

Q Unassigned

R

S Unassigned

T

U

V

W

X Unassigned

Y

Z Unclassified

*1L AA 001 0 B1 LD1 ,LOAD ACCUMULATOR S.L. 4 54US 1
THE CONTENTS OF G ARE PLACED IN $AL.

*1L AA 002 0 B2 LD2 ,LOAD ACCUMULATOR D.L. 6 78US 1
THE CONTENTS OF G,G+1 ARE PLACED IN $AL,$AR.

*1L AA 003 0 B1 LN1 ,LOAD NUMERIC S.L. 8 66US 1
THE ABSOLUTE VALUE OF THE CONTENTS OF G IS PLACED IN $AL.

*1L AA 004 0 B2 LN2 ,LOAD NUMERIC D.L. 12 96US 1
THE ABSOLUTE VALUE OF THE CONTENTS OF G,G+1 IS PLACED IN $AL,$AR.

*1L AA 005 0 B1 LC1 ,LOAD COMPLEMENT S.L. 6 66US 1
THE TWO-S COMPLEMENT OF THE CONTENTS OF G IS PLACED IN $AL.

*1L AA 006 0 B2 LC2 ,LOAD COMPLEMENT D.L. 10 120US 1
THE TWO-S COMPLEMENT OF THE CONTENTS OF G,G+1 IS PLACED IN $AL,$AR.

*1L AA 007 0 B1 IA1 ,LOAD INDIRECT AC S.L. 4 60US 0
THE CONTENTS OF $AL ARE USED TO ADDRESS A WORD WHOSE CONTENTS ARE
PLACED IN $AL.

*1L AA 008 0 B2 IA2 ,LOAD INDIRECT AC D.L. 6 84US 0
THE CONTENTS OF $AL ARE USED TO ADDRESS A DOUBLE LENGTH FIELD WHOSE
CONTENTS ARE PLACED IN $AL,$AR.

*1L AA 009 0 B1 LQ1 ,LOAD MQ S.L. 4 54US 1
THE CONTENTS OF G ARE PLACED IN $AR.

*1L AA 010 0 B2 LQ2 ,LOAD MQ D.L. 6 78US 1
THE CONTENTS OF G,G+1 ARE PLACED IN $QL,$QR.

*1L AB 011 0 B1 ST1 ,STORE ACCUMULATOR S.L. 4 54US 1
THE CONTENTS OF $AL ARE STORED AT G.

*1L AB 012 0 B2 ST2 ,STORE ACCUMULATOR D.L. 6 78US 1
THE CONTENTS OF $AL,$AR ARE STORED AT G,G+1.

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*1L AB 013 0 B1  SQ1   ,STORE MQ S.L.                                  4    54US          1
                 THE CONTENTS OF $AR ARE STORED AT G.

*1L AB 014 0 B2  SQ2   ,STORE MQ D.L.                                  6    78US          1
                 THE CONTENTS OF $QL,$QR ARE STORED AT G,G+1.

*1L AC 067 0 L   MVN   ,MOVE                                          8108+12US          3
                 MOVE N 15-BIT WORDS,STARTING AT G,TO LOCATIONS H THROUGH H+N-1.

*1L AD 015 0 B1  SZ1   ,STORE ZERO S.L.                               3    42US          1
                 LOCATION G IS CLEARED TO ZERO.

*1L AD 016 0 B2  SZ2   ,STORE ZERO D.L.                               4    54US          1
                 LOCATIONS G,G+1 ARE CLEARED TO ZERO.

*1L AE 065 0 D   BBD   ,BINARY TO BCD                                43   983US
                 THE CONTENTS OF $AL,$AR ARE CONVERTED TO ONE 2 BIT AND SEVEN 4-BIT
                 BCD CHARACTERS AND PLACED IN $AL,$AR RIGHT ADJUSTED. THE NUMBER
                 MUST BE POSITIVE AND NOT EXCEED 230,454,778.(39,999,999).

*1L AE 066 0 B2  BBN   ,BCD TO BINARY                                67   945US          0
                 THE CONTENTS OF $AL,$AR ARE TREATED AS ONE 2 BIT AND SEVEN 4-BIT
                 BCD CHARACTERS AND CONVERTED TO AN UNSIGNED BINARY NUMBER, RIGHT
                 ADJUSTED AND PLACED IN $AL,$AR. NUMBER MUST BE POSITIVE AND NOT
                 EXCEED 230,454,778 (39,999,999).

*1L AZ 017 0 B1  EX1   ,EXCHANGE S.L.                                 5    60US          0
                 THE CONTENTS OF $AL ARE EXCHANGED WITH THE CONTENTS OF $AR.

*1L AZ 018 0 B2  EX2   ,EXCHANGE D.L.                                 8    96US          0
                 THE CONTENTS OF $AL,$AR ARE EXCHANGED WITH THE CONTENTS OF $QL,$QR.

*1L BA 019 0 B1  AD1   ,ADD S.L.                                      5    66US          1
                 THE CONTENTS OF G ARE ADDED TO $AL,AND THE SUM IS PLACED IN $AL.
                 OVERFLOW IS POSSIBLE.

*1L BA 020 0 B2  AD2   ,ADD D.L.                                      9   114US          1
                 THE CONTENTS OF G,G+1 ARE ADDED TO $AL,$AR. THE SUM IS PLACED IN
                 $AL,$AR. OVERFLOW IS POSSIBLE.
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*1L BB 021 0 B1  SB1   ,SUBTRACT S.L.                          6    78US        1
                THE CONTENTS OF G ARE SUBTRACTED FROM THE CONTENTS OF $AL AND THE
                DIFFERENCE IS PLACED IN $AL. OVERFLOW IS POSSIBLE.

*1L BB 022 0 B2  SB2   ,SUBTRACT D.L.                          9   120US        1
                THE DOUBLE LENGTH NUMBER LOCATED AT G,G+1 WILL BE SUBTRACTED FROM
                THE CONTENTS OF $AL,$AR AND THE DIFFERENCE IS PLACED IN $AL,$AR.
                OVERFLOW IS POSSIBLE.

*1L BC 023 0 B1  MP1   ,MULTIPLY S.L.                         23   168US        1
                THE CONTENTS OF G ARE MULTIPLIED BY THE CONTENTS OF $AL. THE HIGH
                ORDER PORTION OF THE SIGNED 28-BIT PRODUCT IS PLACED IN $AL,THE LOW
                PORTION IN $AR.

*1L BC 024 0 B2  MP2   ,MULTIPLY D.L.                         73   627US        1
                THE DOUBLE LENGTH NUMBER AT G,G+1 IS MULTIPLIED BY THE CONTENTS OF
                $AL,$AR. THE HIGH ORDER PORTION OF THE 58-BIT PRODUCT IS PLACED IN
                $AL,$AR,THE LOW ORDER PORTION IN $QL,$QR.

*1L BD 025 0 B1  DV1   ,DIVIDE S.L.                           46   180US        1
                THE CONTENTS OF $AL,$AR ARE DIVIDED BY THE CONTENTS OF G. THE
                SIGNED QUOTIENT IS PLACED IN $AL AND THE REMAINDER IS PLACED IN
                $AR.
                THE MACHINE OVERFLOW INDICATOR WILL BE SET IF THE ABSOLUTE VALUE OF
                THE DIVISOR IS LESS THAN THE ABSOLUTE VALUE OF THE DIVIDEND.

*1L BD 026 0 B2  DV2   ,DIVIDE D.L.                         148  1062US        1
                THE CONTENTS OF $AL,$AR AND $QL ARE DIVIDED BY THE CONTENTS OF G,
                G+1. THE QUOTIENT IS PLACED IN $AL,$AR. THE VALUE LEFT IN $QL,$QR
                IS MEANINGLESS.
                THE MACHINE OVERFLOW INDICATOR WILL BE SET IF THE ABSOLUTE VALUE
                OF THE DIVISOR IS LESS THAN THE ABSOLUTE VALUE OF THE DIVIDEND. THE
                DIVISOR SHOULD NOT BE LESS THAN 2-14.

*1L CA 077 0 B1  SR1   ,SQUARE ROOT S.L.                      49   606US        0
                THE SQUARE ROOT OF THE SIGNED 29 BIT NUMBER IN $AL,$AR IS PLACED
                IN $AL,$AR. THE SCALE OF THE ROOT IS ONE HALF OF THE SCALE OF THE
                OPERAND,WHICH MUST BE SCALED EVENLY. THE ROOT IS COMPUTED TO 14
                BITS. LEADING ZEROS ARE MEANINGLESS.
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*1L CA 078 0 B2 SR2 ,SQUARE ROOT D.L. 99 2280US 0
THE SQUARE ROOT OF THE SIGNED 59-BIT NUMBER IN $AL,$AR,$QL,$QR IS PLACED IN $AL,$AR. THE RESULTING CONTENTS OF $QL,$QR ARE MEANINGLESS.
SUBROUTINES REQUIRED- SR1SR,50 CELLS,1PBD082 DV2SR,91 CELLS, 1PAA0850.

*1L CB 069 0 B1 SN1 ,SINE S.L. 81 951US 0
THE VALUE IN $AL IS TREATED AS A SIGNED 14-BIT ARGUMENT IN RADIANS SCALED 2-3. THE SIGNED RESULT IS PLACED IN $AL,SCALED 2 .

*1L CB 070 0 B2 SN2 ,SINE D.L. 219 5085US 0
THE VALUE IN $AL,$AR IS TREATED AS A SIGNED 29 BIT ARGUMENT IN RADIANS SCALED 2-3. THE SIGNED RESULT IS PLACED IN $AL,$AR,SCALED 2-0.
SUBROUTINES REQUIRED- MP2SR,27 CELLS,1PAA084 .

*1L CC 071 0 B1 CS1 ,COSINE S.L. 86 873US 0
THE VALUE IN $AL IS TREATED AS A SIGNED 14-BIT ARGUMENT IN RADIANS SCALED 2-3. THE SIGNED FRACTIONAL RESULT IS PLACED IN $AL.

*1L CC 072 0 B2 CS2 ,COSINE D.L. 79 5181US 0
THE VALUE IN $AL,$AR IS TREATED AS A SIGNED 29 BIT ARGUMENT IN RADIANS SCALED 2-3. THE SIGNED FRACTIONAL RESULT PLACED IN $AL,$AR.
SUBROUTINES REQUIRED- SN2,219 CELLS,1PBA 700 MP2SR,27 CELLS, 1PAA0840.

*1L CD 075 0 B1 AS1 ,ARC SINE S.L. 62 1563US 0
THE VALUE IN $AL IS TREATED AS A SIGNED 14-BIT FRACTIONAL ARGUMENT. THE SIGNED RESULT IS PLACED IN $AL IN RADIANS SCALED 2-1.
SUBROUTINES REQUIRED- SR1SR,50 CELLS,1PBD082 AT1SR,36 CELLS, 1PBA0800- AT1TX TABLE,66 CELLS,1PBZ0790.

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*1L CD 076 0 B2  AS2   ,ARC SINE D.L.                          95  7598US          0
                THE VALUE IN THE ACCUMULATOR $AL,$AR IS TREATED AS A SIGNED 29-BIT
                FRACTIONAL ARGUMENT. THE SIGNED RESULT IS PLACED IN THE ACCUMULATOR
                $AL,$AR IN RADIANS SCALED 2-1.
                SUBROUTINES REQUIRED- MP2SR,27 CELLS,1PAA084   DV2SR,91 CELLS,
                1PAA0850- AT2SR,107 CELLS,1PBA0810-SR1SR,50 CELLS,1PBD0820-
                AT1TX TABLE,66 CELLS,1PBZ0790-SR2SR,75 CELLS,1PBD 830.

*1L CE 073 0 B1  AT1   ,ARC TANGENT S.L.                       46   555US          0
                THE VALUE IN $AL IS TREATED AS A SIGN 14 BIT FRACTIONAL ARGUMENT.
                THE SIGNED RESULT IS PLACED IN $AL IN RADIANS SCALED 2- .
                SUBROUTINES REQUIRED- AT1TX TABLE,66 CELLS,1PBZ0790.

*1L CE 074 0 B2  AT2   ,ARC TANGENT D.L.                       82  2979US          0
                THE VALUE IN $AL,$AR IS TREATED AS A SIGNED 29 BIT FRACTIONAL
                ARGUMENT. THE SIGNED RESULT IS PLACED IN $AL,$AR IN RADIANS SCALED
                2-0.
                SUBROUTINES REQUIRED- MP2SR,27 CELLS,1PAA084   DV2SR,91 CELLS,
                1PAA0850- AT1TX TABLE,66 CELLS,1PBZ0790.

*1L DA 048 0 B1  NR1   ,NUMERIC RIGHT SHIFT S.L.               21138+3NUS         1
                THE CONTENTS OF $AL ARE SHIFTED RIGHT N PLACES. THE ORIGINAL SIGN
                OF $AL IS PROPAGATED.
                0 LESS THAN OR EQUAL TO N LESS THAN OR EQUAL TO 14.

*1L DA 049 0 B2  NR2   ,NUMERIC RIGHT SHIFT D.L.               50252+3NUS         1
                THE CONTENTS OF $AL,$AR ARE SHIFTED RIGHT N PLACES. THE ORIGINAL
                SIGN OF $AL IS PROPAGATED.
                0 LESS THAN OR EQUAL TO N LESS THAN OR EQUAL TO 29.

*1L DB 045 0 B1  NL1   ,NUMERIC LEFT SHIFT S.L.                13120+3NUS         1
                THE CONTENTS OF $AL ARE SHIFTED LEFT N PLACES. BITS SHIFTED OUT OF
                BIT POSITION 14 ARE LOST,AND THE VACATED POSITIONS ARE FILLED WITH
                ZEROS. THE SIGN OF $AL IS UNCHANGED.
                0 LESS THAN OR EQUAL TO N LESS THAN OR EQUAL TO 14.

*1L DB 046 0 B2  NL2   ,NUMERIC LEFT SHIFT D.L.                24168+3NUS         1
                THE CONTENTS OF $AL,$AR ARE SHIFTED LEFT N PLACES. BITS SHIFTED OUT
                OF BIT POSITION 14 OF $AL ARE LOST AND THE VACATED POSITIONS ARE
                FILLED WITH ZEROS. THE SIGN OF $AL IS UNCHANGED.
                0 LESS THAN OR EQUAL TO N LESS THAN OR EQUAL TO 29.
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*1L DC 050 0 B2  NR4    ,NUMERIC RIGHT SHIFT QUAD.L.          51330+9NUS        1
                 THE CONTENTS OF $AL,$AR AND $QL,$QR ARE SHIFTED RIGHT N PLACES. THE
                 ORIGINAL SIGN OF $AL IS PROPAGATED.
                 0 LESS THAN OR EQUAL TO N LESS THAN OR EQUAL TO 29.

*1L DD 047 0 B2  NL4    ,NUMERIC LEFT SHIFT QUAD.L.           60329+3NUS        1
                 THE CONTENTS OF $AL,$AR AND $QL,$QR ARE SHIFTED LEFT N PLACES. BITS
                 SHIFTED OUT OF BIT POSITION 14 OF $AL ARE LOST AND THE VACATED
                 POSITIONS ARE FILLED WITH ZEROS. THE SIGN OF $AL IS UNCHANGED.
                 0 LESS THAN OR EQUAL TO N LESS THAN OR EQUAL TO 29.

*1L DE 053 0 B1  LR1    ,LOGICAL RIGHT SHIFT S.L.              9 96+3NUS        1
                 THE CONTENTS OF $AL ARE SHIFTED RIGHT N PLACES. BITS SHIFTED OUT OF
                 $AL ARE LOST. POSITIONS VACATED ARE FILLED WITH ZEROS.
                 0 LESS THAN OR EQUAL TO N LESS THAN OR EQUAL TO 15.

*1L DE 054 0 B2  LR2    ,LOGICAL RIGHT SHIFT,D.L.             21144+3NUS        1
                 THE CONTENTS OF $AL,$AR ARE SHIFTED RIGHT N PLACES. BITS SHIFTED
                 OUT OF $AL,$AR ARE LOST. VACATED BITS ARE FILLED WITH ZEROS.
                 0 LESS THAN OR EQUAL TO N LESS THAN OR EQUAL TO 3 .

*1L DF 051 0 B1  LL1    ,LOGICAL LEFT SHIFT S.L.               9 96+3NUS        1
                 THE CONTENTS OF $AL ARE SHIFTED LEFT N PLACES. BITS SHIFTED OUT OF
                 $AL ARE LOST AND ZEROS ARE INSERTED IN THE VACATED POSITIONS.
                 0 LESS THAN OR EQUAL TO N LESS THAN OR EQUAL TO 15.

*1L DF 052 0 B2  LL2    ,LOGICAL LEFT SHIFT D.L.              21144+3NUS        1
                 THE CONTENTS OF $AL,$AR ARE SHIFTED LEFT N PLACES. THE BITS VACATED
                 AT THE LOW ORDER POSITION OF $AR ARE FILLED WITH ZEROS,AND BITS
                 SHIFTED OUT OF THE SIGN POSITION ARE LOST.
                 0 LESS THAN N LESS THAN OR EQUAL TO 30.

*1L DP 055 0 B1  FL1    ,FLOAT LEFT S.L.                       8 84+3NUS        0
                 THE CONTENTS $AL ARE SHIFTED LEFT UNTIL BITS 14 AND 15 DIFFER. THE
                 NUMBER OF POSITIONS SHIFTED IS PLACED IN $AR.

*1L DP 056 0 B2  FL2    ,FLOAT LEFT D.L.                      18198+3NUS        0
                 THE CONTENTS OF $AL,$AR ARE SHIFTED LEFT UNTIL BITS 14 AND 15 OF
                 $AL DIFFER. THE NUMBER OF POSITIONS SHIFTED IS PLACED IN $QR.
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*1L EA 043 0 L   HPN   ,HALT AND PROCEED                          3    36US        1
                 IF THE COMPUTER IS RUNNING IN THE FLAG MODE,A HALT WILL OCCUR. UPON
                 RESTART A BRANCH TO LOCATION G IS EXECUTED.

*1L EB 028 0 B1  BPN   ,BRANCH ON POSITIVE ACCUM.                 5    48US        1
                 IF THE CONTENTS OF $AL ARE POSITIVE A BRANCH TO THE ADDRESS IN
                 LOCATION G IS EXECUTED.

*1L EB 029 0 B1  BMN   ,BRANCH ON MINUS ACCUM.                    5    48US        1
                 IF THE CONTENTS OF $AL ARE NEGATIVE,A BRANCH TO THE ADDRESS IN
                 LOCATION G IS EXECUTED

*1L EB 031 0 Z   BVN   ,BRANCH ON OVERFLOW                        4    36US        1
                 IF THE OVERFLOW INDICATOR IS SET A BRANCH TO THE ADDRESS IN
                 LOCATION G IS EXECUTED. THE OVERFLOW INDICATOR IS SET TO ZERO.

*1L EB 032 0 Z   BDK   ,BRANCH ON DIVIDE CHECK                    7    60US        1
                 IF THE CONTENTS OF $DK ARE ONE,A BRANCH TO THE ADDRESS IN LOCATION
                 G IS EXECUTED AND $DK IS SET TO ZERO.

*1L EC 033 0 B1  BZ1   ,BRANCH ON ACCUMULATOR ZERO S.L.           5    48US        1
                 IF THE CONTENTS OF $AL ARE ZERO,A BRANCH TO THE ADDRESS IN LOCATION
                 G IS EXECUTED.

*1L EC 034 0 B2  BZ2   ,BRANCH ON ACCUMULATOR ZERO D.L.           6    60US        1
                 IF THE CONTENTS OF $AL,$AR ARE ZERO,A BRANCH TO THE ADDRESS IN
                 LOCATION G IS EXECUTED.

*1L EE 035 0 B1  CE1   ,COMPARE EQUAL S.L.                        9   108US        2
                 IF THE CONTENTS OF $AL EQUAL THE CONTENTS OF G,A BRANCH TO THE
                 ADDRESS IN LOCATION H OCCURS.

*1L EE 036 0 B2  CE2   ,COMPARE EQUAL D.L.                       13   144US        2
                 IF THE CONTENTS OF $AL,$AR EQUAL THE CONTENTS OF G,G+1,A BRANCH TO
                 THE ADDRESS IN LOCATION H OCCURS.

*1L EE 037 0 B1  CG1   ,COMPARE GREATER S.L.                      9   108US        2
                 IF THE CONTENTS OF $AL ARE EQUAL TO OR GREATER THAN THE CONTENTS OF
                 G,A BRANCH TO THE ADDRESS IN LOCATION H OCCURS.
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*1L EE 038 0 B2  CG2   ,COMPARE GREATER D.L.                    14   150US        2
                 IF THE CONTENTS OF $AL,$AR ARE GREATER THAN OR EQUAL TO THE
                 CONTENTS OF G,G+1 A BRANCH TO THE ADDRESS IN LOCATION H OCCURS.

*1L EE 039 0 B1  CL1   ,COMPARE LESS S.L.                       9   108US        2
                 IF THE CONTENTS OF $AL ARE LESS THAN THE CONTENTS OF G,A BRANCH TO
                 THE ADDRESS IN LOCATION H OCCURS.

*1L EE 040 0 B2  CL2   ,COMPARE LESS D.L.                      14   150US        2
                 IF THE CONTENTS OF $AL,$AR ARE LESS THAN THE CONTENTS OF G,G+1,
                 A BRANCH TO THE ADDRESS IN LOCATION H OCCURS.

*1L EG 027 0 Z   BUN   ,BRANCH UNCONDITIONAL                    3    36US        1
                 AN UNCONDITIONAL BRANCH TO THE ADDRESS IN LOCATION G IS EXECUTED.

*1L EH 042 0 L   LJN   ,LINK JUMP                               5    60US        2
                 THE ADDRESS OF THE NEXT LOGRAM STARTING ADDRESS IS STORED AT G AND
                 A BRANCH TO THE ADDRESS IN H IS EXECUTED.

*1L EH 044 0 L   LVN   ,LEAVE INTERPRETIVE MODE                 5    60US        2
                 STORE ADDRESS G AT $RET. BRANCH UNCONDITIONALLY TO LOCATION H WHICH
                 CONTAINS A SUBROUTINE WRITTEN IN LOGAND LANGUAGE. TO RETURN TO
                 INTERPRETIVE MODE AT LOCATION G IN $RET,LOGAND LP/IL/$RET MUST BE
                 EXECUTED.

*1L EJ 030 0 L   BAN   ,BRANCH TO ACCUM. ADDRESS                2    30US        0
                 AN UNCONDITIONAL BRANCH IS MADE TO THE ADDRESS IN $AL.

*1L EJ 041 0 L   TDN   ,TEST AND DECREMENT                      9   108US        2
                 THE CONTENTS OF LOCATION G ARE DECREMENTED BY ONE. IF THE CONTENTS
                 OF G THEN EQUAL ZERO,A BRANCH TO THE ADDRESS IN LOCATION H OCCURS.

*1L FA 063 0 B1  DG1   ,DOT G(AND) S.L.                         4    54US        1
                 THE CONTENTS OF G ARE COMPARED WITH THE CORRESPONDING BITS OF $AL
                 A) IF THE CORRESPONDING BITS ARE ONES,THE RESULT IS ONE. B) IF
                 EITHER OF THE CORRESPONDING BITS IS A ZERO,THE RESULT IS ZERO. THE
                 RESULTS ARE PLACED IN $AL.
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*1L FA 064 0 B2  DG2    ,DOT G(AND) D.L.                          7    90US          1
          THE CONTENTS OF G,G+1 ARE COMPARED WITH THE CORRESPONDING BITS OF
          $AL,$AR A) IF THE CORRESPONDING BITS ARE ONES,THE RESULT IS ONE. B)
          IF EITHER OF THE CORRESPONDING BITS IS A ZERO,THE RESULT IS ZERO.
          THE RESULTS ARE PLACED IN $AL,$AR.

*1L FB 061 0 B1  OR1    ,INCLUSIVE OR S.L.                        4    54US          1
          THE CONTENTS OF G ARE COMPARED WITH CORRESPONDING BITS OF $AL.
          IF CORRESPONDING BITS ARE ZERO,THE RESULT IS ZERO. IF EITHER OF
          THE CORRESPONDING BITS IS ONE,THE RESULT IS ONE. THE RESULTS ARE
          PLACED IN $AL.

*1L FB 062 0 B2  OR2    ,INCLUSIVE OR D.L.                        7    90US          1
          THE CONTENTS OF G,G+1 ARE COMPARED WITH THE CORRESPONDING BITS OF
          $AL,$AR A) IF CORRESPONDING BITS ARE ZERO,THE RESULT IS ZERO. B) IF
          EITHER OF THE CORRESPONDING BITS IS ONE THE RESULT IS ONE.

*1L FD 059 0 B1  IN1    ,INSERT S.L.                              7    96US          2
          THIS LOGRAM COMBINES PORTIONS OF THE TWO WORDS IN $AL AND LOCATION
          H INTO $AL. ONE BITS IN THE MASK LOCATED AT G CONTROL THE BITS OF
          $AL TO BE INSERTED. ZERO BITS OF THE MASK CONTROL THE PORTION OF
          THE CONTENTS OF H TO BE INSERTED.

*1L FD 060 0 B2  IN2    ,INSERT D.L.                             17   222US          2
          THIS LOGRAM COMBINES PORTIONS OF THE TWO DOUBLE LENGTH WORDS IN
          $AL,$AR,H,H+1 INTO $AL,$AR. ONE BITS OF THE MASK LOCATED AT G,G+1
          CONTROL THE BITS OF $AL,$AR TO BE INSERTED. ZERO BITS OF THE MASK
          CONTROL THE PORTION OF THE CONTENTS OF H,H+1 TO BE INSERTED.

*1L FE 057 0 B2  OC1    ,ONE-S COMPLEMENT OF ACC. S.L.            5    60US          0
          THE ONE-S COMPLEMENT OF $AL IS PLACED IN $AL.

*1L FE 058 0 B2  OC2    ,ONE-S COMPLEMENT OF ACC. D.L.            8    96US          0
          THE ONE-S COMPLEMENT OF THE CONTENTS OF $AL,$AR IS PLACED IN $AL,
          $AR.

*1L GA 068 0 L   TL1    ,TABLE LOOK UP.                          21 216+12N         3
          THE CONTENTS OF $AL ARE COMPARED SEQUENTIALLY WITH N WORDS IN A
          TABLE,STARTING AT G,UNTIL THE SPECIFIED CONDITION IS SATISFIED.
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OPTIONAL ARITHMETIC SET

1L BA 144 0 B2 SA2 ,STORE ADD-DOUBLE LENGTH. 14 162US 2
ADDS THE CONTENTS OF $AL,$AR TO THE CONTENTS OF G,G+1 AND PLACES THE RESULT IN $AL,$AR AND H,H+1. IF OVERFLOW OCCURS, A FLAG BRANCH IS EXECUTED.
LOGRAMS REQUIRED- OVNS,2 CELLS, 1PNA156.

1L BA 147 0 B1 SA1 ,STORE ADD-SINGLE LENGTH. 8 96US 2
ADDS CONTENTS OF $AL TO CONTENTS OF G AND PLACES RESULT IN H. IF OVERFLOW OCCURS,A FLAG BRANCH IS EXECUTED.
LOGRAMS REQUIRED- OVNS,2 CELLS, 1PNA156.

1L BA 148 0 B1 AO1 ,ADD ONE-SINGLE LENGTH. 9 96US 1
INCREMENTS THE CONTENTS OF G BY ONE. IF OVERFLOW OCCURS,A FLAG BRANCH IS EXECUTED.
LOGRAMS REQUIRED- OVNS,2 CELLS, 1PNA156.

1L BA 150 0 B1 AD1 ,ADD-SINGLE LENGTH. 7 78US 1
ADDS CONTENTS OF $AL TO CONTENTS OF G AND PLACES RESULT IN $AL. IF OVERFLOW OCCURS, A FLAG BRANCH IS EXECUTED.
LOGRAMS REQUIRED- OVNS,2 CELLS, 1PNA156.

1L BA 151 0 B2 AD2 ,ADD-DOUBLE LENGTH. 11 126US 2
ADDS CONTENTS OF $AL,$AR TO CONTENTS OF G,G+1 AND PLACES RESULT IN $AL,$AR. IF OVERFLOW OCCURS,A FLAG BRANCH IS EXECUTED.
LOGRAMS REQUIRED- OVNS,2 CELLS, 1PNA156.

1L BB 141 0 B1 SO1 ,SUBTRACT ONE-SINGLE LENGTH. 9 108US 1
SUBTRACTS ONE FROM THE CONTENTS OF G AND STORES THE RESULT IN $AL AND IN G. IF OVERFLOW OCCURS,A FLAG BRANCH IS EXECUTED.
LOGRAMS REQUIRED- OVNS,2 CELLS, 1PNA156.

1L BB 152 0 B1 SB1 ,SUBTRACT-SINGLE LENGTH. 8 90US 1
SUBTRACTS (G) FROM ($AL) AND PLACES THE RESULT IN $AL. IF OVERFLOW OCCURS,A FLAG BRANCH IS EXECUTED.
LOGRAMS REQUIRED- OVNS,2 CELLS,1PNA156.

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1L BB 157 0 B2  SB2    ,SUBTRACT-DOUBLE LENGTH.                  9   120US        1
          THE CONTENTS OF G,G+1 ARE SUBTRACTED FROM THE CONTENTS OF $AL,$AR.
          THE RESULTS ARE PLACED IN $AL,$AR. IF OVERFLOW OCCURS,A FLAG
          BRANCH IS EXECUTED.
          LOGRAMS REQUIRED- OVNS,2 CELLS, 1PNA156.
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ADDITIONAL LOGRAM SET

1L AA 124 0 B2 LK2 ,LOAD CONSTANT-DOUBLE LENGTH. 6 72US 2
LOADS $AL,$AR WITH G AND H RESPECTIVELY.

1L AA 127 0 B1 LK1 ,LOAD CONSTANT-SINGLE LENGTH. 4 48US 1
LOADS $AL WITH G.

1L AA 154 0 B4 LD4 ,LOAD-QUADRUPLE LENGTH. 10 132US 1
LOADS THE QUADRUPLE LENGTH ACCUMULATOR,$AL,$AR,$QL,$QR WITH THE CONTENTS OF G,G+1,G+2,G+3 RESPECTIVELY.

1L AA 161 0 B3 IA3 ,INDIRECT LOAD-TRIPLE LENGTH. 8 108US 1
A TRIPLE LENGTH LOAD IS EXECUTED USING THE CONTENTS OF $AL AS AN ADDRESS. THE TRIPLE LENGTH WORD IS PLACED IN $AL,$AR,$QL.

1L AA 166 0 B3 LD3 ,LOAD-TRIPLE LENGTH. 8 102US 1
LOADS THE CONTENTS OF G,G+1,G+2 INTO $AL,$AR,$QL.

1L AB 128 0 B1 SI1 ,STORE INDIRECT-SINGLE LENGTH. 5 72US 1
STORES CONTENTS OF $AL INTO (G).

1L AB 153 0 B4 ST4 ,STORE-QUADRUPLE LENGTH. 10 126US 1
STORES THE CONTENTS OF THE QUADRUPLE LENGTH ACCUMULATOR,$AL,$AR, $QL,$QR INTO G,G+1,G+2,G+3.

1L AB 162 0 L3 SZ3 ,TRIPLE LENGTH CLEAR. 5 66US 1
STORES ZERO INTO G,G+1,G+2.

1L AB 164 0 B3 ST3 ,STORE-TRIPLE LENGTH. 8 102US 1
STORES TRIPLE LENGTH WORD CONTAINED IN $AL,$AR,$QL INTO G,G+1,G+2.

1L AE 121 0 B1 BG1 ,BINARY TO GRAY-SINGLE LENGTH. 9 111US 0
PERFORMS CONVERSION FROM BINARY CODE TO GRAY CODE ON CONTENTS OF $AL.

1L AE 122 0 B2 BG2 ,BINARY TO GRAY-DOUBLE LENGTH. 16 201US 0
PERFORMS CONVERSION FROM BINARY CODE TO GRAY CODE ON CONTENTS OF DOUBLE LENGTH PSEUDO ACC.$AL,$AR.

1L AF 180 0 HTB ,HOLLERITH TO BINARY CONVERSION 69 861US
THE CONTENTS OF $AL,$AR,$QL,$QR ARE TREATED AS A SIGNED INTEGRAL NUMBER WHICH IS CONVERTED TO A SIGNED BINARY NUMBER SCALED 2-29 AND STORED IN LOCATIONS G,G+1.

1L AF 181 0 BTH ,BINARY TO HOLLERITH CONVERSION. 59 1075US
THE CONTENTS OF G,G+1 ARE TREATED AS A SIGNED DOUBLE PRECISION NUMBER WHICH IS CONVERTED TO A SIGNED 8 CHARACTER HOLLERITH FIELD AND STORED IN $AL,$AR,$QL,$QR.

1L AF 184 0 TTH ,TELETYPE TO TYPEWRITER CONVERSION. 168
CONVERT A BLOCK OF TELETYPE CODE TO 6-BIT TYPEWRITER CODE PACKED 2 CHARACTERS PER WORD.

1L AF 185 0 HTT ,TYPEWRITER TO TELETYPE CONVERSION. 213
CONVERT A BLOCK OF 6-BIT TYPEWRITER CODE TO TELETYPE CODE PACKED 3 CHARACTERS PER WORD.

1L AG 182 0 OTT ,OCTAL TO TELETYPE CODE CONVERSION. 61 1200US
CONVERTS CONTENTS OF THE A REGISTER TO 5 TELETYPE DIGITS AND STORES RESULT IN $AL,$AR.

1L AH 183 0 TTO ,TELETYPE TO OCTAL CODE CONVERSION. 72 1780US
CONVERTS CONTENTS OF $AL,$AR WHICH HAS BEEN LOADED WITH A FIGURES CODE AND FIVE OCTAL TELETYPE DIGITS TO OCTAL AND STORES RESULT IN THE A REGISTER.

1L BA 123 0 B1 HA1 ,HOLD ADD-SINGLE LENGTH. 4 120US 2
THE CONTENTS OF G ARE ADDED TO THE CONTENTS OF H. THE RESULT IS PLACED IN $AL. OVERFLOW TREATMENT DEPENDS ON ARITHMETIC SET USED.
LOGRAMS REQUIRED- AD1,1LBA019 OR 1LBA150.

1L BA 145 0 B2 AK2 ,ADD CONSTANT-DOUBLE LENGTH. 5 132US 2
ADDS G,H TO CONTENTS OF $AL,$AR AND PLACES THE RESULT IN $AL,$AR.
OVERFLOW TREATMENT DEPENDS ON ARITHMETIC SET USED.
LOGRAMS REQUIRED- AD2,1LBA020 OR 1LBA151.

1L BA 146 0 B2 HA2 ,HOLD ADD-DOUBLE LENGTH. 7 204US 2
ADDS THE CONTENTS OF G,G+1 TO H,H+1 AND STORES RESULT IN $AL, $AR.
OVERFLOW TREATMENT DEPENDS ON ARITHMETIC SET USED.
LOGRAMS REQUIRED- AD2,1LBA020 OR 1LBA151.

1L BA 149 0 B1 AK1 ,ADD CONSTANT-SINGLE LENGTH. 3 84US 1
ADDS CONTENTS OF $AL TO G AND PLACES RESULT IN $AL.
OVERFLOW TREATMENT DEPENDS ON ARITHMETIC SET USED.
LOGRAMS REQUIRED- AD1,1LBA019 OR 1LBA150.

1L BA 155 0 B4 AD4 ,ADD-QUADRUPLE LENGTH. 15 258US 1
THE CONTENTS OF $AL,$AR,$QL,$QR ARE ADDED TO CONTENTS OF G,G+1,
G+2,G+3 RESPECTIVELY. THE RESULT IS PLACED IN $AL,$AR,$QL,$QR.
OVERFLOW TREATMENT DEPENDS ON ARITHMETIC SET USED.
LOGRAMS REQUIRED- AD2,1LBA020 OR 1LBA151.

1L BB 119 0 B1 IS1 ,INVERSE SUBTRACT-SINGLE LENGTH. 6 78US 1
THE CONTENTS OF $AL WILL BE SUBTRACTED FROM THE CONTENTS OF G.
THE DIFFERENCE WILL BE PLACED IN $AL. OVERFLOW INDICATOR SET IF
THERE IS OVERFLOW.

1L BB 142 0 B1 SK1 ,SUBTRACT CONSTANT-SINGLE LENGTH. 3 96US 1
SUBTRACTS G FROM CONTENTS OF $AL AND PLACES RESULT IN $AL.
OVERFLOW TREATMENT DEPENDS ON ARITHMETIC SET USED.
LOGRAMS REQUIRED- SB1,1LBB021 OR 1LBB152.

1L BB 143 0 B1 HS1 ,HOLD SUBTRACT-SINGLE LENGTH. 4 132US 2
SUBTRACTS CONTENTS OF H FROM CONTENTS OF G AND PLACES RESULT
IN $AL. OVERFLOW TREATMENT DEPENDS ON ARITHMETIC SET USED.
LOGRAMS REQUIRED- SB1,1LBB021 OR 1LBB152.

1L BB 158 0 B4 SB4 ,SUBTRACT-QUADRUPLE LENGTH. 15 246US 1
THE CONTENTS OF G,G+1,G+2,G+3 ARE SUBTRACTED FROM THE CONTENTS
OF $AL,$AR,$QL,$QR. THE RESULT IS PLACED IN $AL,$AR,$QL,$QR.
OVERFLOW TREATMENT DEPENDS ON ARITHMETIC SET USED.
LOGRAMS REQUIRED- SB2,1LBB022 OR 1LBB157.

1L BB 159 0 B2 HS2 ,HOLD SUBTRACT-DOUBLE LENGTH. 7 210US 2
THE CONTENTS OF H,H+1 ARE SUBTRACTED FROM THE CONTENTS OF G,G+1. THE RESULT IS PLACED IN $AL,$AR. OVERFLOW TREATMENT DEPENDS ON ARITHMETIC SET USED.
LOGRAMS REQUIRED- SB2,1LBB022 OR 1LBB157.

1L BB 160 0 B2 SK2 ,SUBTRACT CONSTANT-DOUBLE LENGTH. 5 138US 1
G,G+1 IS SUBTRACTED FROM THE CONTENTS OF $AL,$AR AND RESULT IS PLACED IN $AL,$AR. OVERFLOW TREATMENT DEPENDS ON ARITHMETIC SET USED.
LOGRAMS REQUIRED- SB2,1LBB022 OR 1LBB157.

1L BB 163 0 B3 SB3 ,SUBTRACT-TRIPLE LENGTH. 11 102US 1
THE CONTENTS OF G,G+1,G+2 ARE SUBTRACTED FROM THE CONTENTS OF $AL,$AR,$QL. THE RESULT IS PLACED IN $AL,$AR,$QL. OVERFLOW TREATMENT DEPENDS ON ARITHMETIC SET USED.
LOGRAMS REQUIRED- SB2,1LBB022 OR 1LBB157.

1L BC 137 0 B2 MK2 ,MULTIPLY CONSTANT-DOUBLE LENGTH 7 621US 1
MULTIPLIES G,G+1 AND CONTENTS OF $AL,$AR AND PLACES THE RESULT IN $AL,$AR,$QL,$QR.
LOGRAMS REQUIRED- MP2,73 CELLS,1LBC024.

1L BC 138 0 B2 HM2 ,HOLD MULTIPLY-DOUBLE LENGTH. 7 701US 2
MULTIPLIES THE CONTENTS OF G,G+1 TIMES THE CONTENTS OF H,H+1 AND PLACES THE RESULT IN $AL,$AR,$QL,$QR.
LOGRAMS REQUIRED- MP2,73 CELLS,1LBC024.

1L BC 139 0 B1 MK1 ,MULTIPLY CONSTANT-SINGLE LENGTH. 4 192US 1
MULTIPLIES THE CONTENTS OF $AL BY G AND PLACES THE RESULT IN $AL, $AR.
LOGRAMS REQUIRED- MP1,23 CELLS,1LBC023.

1L BC 140 0 B1 HM1 ,HOLD MULTIPLY-SINGLE LENGTH. 4 210US 2
MULTIPLIES THE CONTENTS OF G BY THE CONTENTS OF H AND PLACES THE RESULT IN $AL,$AR.
LOGRAMS REQUIRED- MP1,23 CELLS,1LBC023.

1L BD 118 0 B1 ID1 ,INVERSE DIVIDE-SINGLE LENGTH. 5 234US 1
THE CONTENTS OF G ARE DIVIDED BY THE CONTENTS OF $AL. THE QUOTIENT IS PLACED IN $AL AND THE REMAINDER IN $AR.
THE MACHINE OVERFLOW INDICATOR WILL BE SET IF THE ABSOLUTE VALUE OF THE DIVISOR IS LESS THAN THE ABSOLUTE VALUE OF THE DIVIDEND.
LOGRAMS REQUIRED- DV1,46 CELLS,1LBD025.

1L BD 167 0 B1 DK1 ,DIVIDE CONSTANT-SINGLE LENGTH. 3 378US 1
DIVIDES THE CONTENTS OF $AL,$AR BY G AND PLACES QUOTIENT IN $AL AND THE REMAINDER IN $AR.
LOGRAMS REQUIRED- DV1,46 CELLS,1LBD025.

1L BD 168 0 B2 DK2 ,DIVIDE CONSTANT-DOUBLE LENGTH. 8 2160US 1
DIVIDES THE CONTENTS OF $AL,$AR,$QL,$QR BY G,G 1 AND PLACES THE QUOTIENT IN $AL,$AR.
LOGRAMS REQUIRED- DV2,148 CELLS,1LBD026.

1L CB 093 0 B1 SN1 ,SINE. 88 1026US 1
COMPUTES SINE OF AN ANGLE EXPRESSED IN DEGREES (SCALED 9) AND PLACES RESULT IN $AL,SCALED 0.

1L CC 094 0 B1 CS1 ,COSINE. 13 1098US 1
COMPUTES THE COSINE OF AN ANGLE EXPRESSED IN DEGREES (SCALED 9) AND PLACES RESULT IN $AL,SCALED 0.
LOGRAMS REQUIRED- SN1,88 CELLS,1LCB093.

1L CE 095 0 B1 AT1 ,ARCTANGENT. 149 1056US 1
COMPUTES THE ARCTANGENT OF THE CONTENTS OF $AL,$AR AND PLACES THE RESULT IN $AL (SCALED 9),IN DEGREES.

1L DJ 130 0 B1 CR1 ,CLOSED RIGHT SHIFT- SINGLE LENGTH. 9 1
EXECUTES A CLOSED RIGHT SHIFT ON THE CONTENTS OF $AL. BITS LEAVING BIT POSITION 1 ENTER BIT POSITION 15.

1L DL 129 0 B2 CR2 ,CLOSED RIGHT SHIFT- DOUBLE LENGTH. 21 1
EXECUTES A CLOSED RIGHT SHIFT ON THE CONTENTS OF THE DOUBLE LENGTH PSEUDO ACC. BITS LEAVING THE LOW ORDER POSITION OF $AL ENTER THE HIGH ORDER POSITION OF $AR. BITS LEAVING THE LOW ORDER POSITION OF $AR ENTER THE HIGH ORDER POSITION OF $AL.

1L EC 131 0 B1 BN1 ,BRANCH ON BIT FALSE. 6 60US 2
FORMS THE LOGICAL PRODUCT OF THE CONTENTS OF G AND THE CONTENTS OF $AL. IF THE PRODUCT IS ZERO,A BRANCH TO THE ADDRESS IN H IS EXECUTED. IF THE PRODUCT IS NOT ZERO,THE NEXT LOGRAM IN SEQUENCE IS EXECUTED.

1L EC 132 0 B1 BO1 ,BRANCH ON BIT TRUE. 8 72US 2
FORMS THE LOGICAL PRODUCT OF THE CONTENTS OF G AND THE CONTENTS OF $AL. IF THE PRODUCT IS NOT ZERO,A BRANCH TO THE ADDRESS IN H IS EXECUTED. IF THE PRODUCT IS ZERO,THE NEXT LOGRAM IN SEQUENCE IS EXECUTED.

1L EJ 133 0 B1 TPN ,TRANSFER ON PLUS-SINGLE LENGTH. 5 54US 2
TESTS CONTENTS OF G. IF EQUAL TO OR GREATER THAN ZERO A BRANCH TO THE ADDRESS IN H IS EXECUTED. IF LESS THAN ZERO,THE NEXT LOGRAM IN SEQUENCE IS EXECUTED.

1L EJ 134 0 B1 TMN ,TRANSFER ON MINUS-SINGLE LENGTH. 5 52US 2
TESTS CONTENTS OF G. IF LESS THAN ZERO,A BRANCH TO THE ADDRESS IN H IS EXECUTED. IF NOT LESS THAN ZERO,THE NEXT LOGRAM IN SEQUENCE IS EXECUTED.

1L EJ 135 0 B2 TZ2 ,TRANSFER ON ZERO-DOUBLE LENGTH. 7 78US 2
TESTS THE DOUBLE LENGTH WORD CONTAINED IN G,G 1. IF EQUAL TO ZERO,A BRANCH TO THE ADDRESS IN H IS EXECUTED. IF NOT EQUAL TO ZERO,THE NEXT LOGRAM IN SEQUENCE IS EXECUTED.

1L EJ 136 0 B1 TZ1 ,TRANSFER ON ZERO-SINGLE LENGTH 5 60US 2
TESTS CONTENTS OF G. IF EQUAL TO ZERO,A BRANCH TO THE ADDRESS IN H IS EXECUTED. IF NOT EQUAL TO ZERO,THE NEXT LOGRAM IN SEQUENCE IS EXECUTED.

1L FC 125 0 L3 ER3 ,EXCLUSIVE OR-TRIPLE LENGTH. 18 228US 1
FORMS THE EXCLUSIVE OR ON THE CONTENTS OF THE TRIPLE LENGTH PSEUDO ACC $AL,$AR,$QL AND THE CONTENTS OF G,G+1,G+2. THE RESULT IS PLACED IN $AL,$AR,$QL.

1L FC 126 0 L1 ER1 ,EXCLUSIVE OR-SINGLE LENGTH. 7 90US 1
FORMS THE EXCLUSIVE OR ON CONTENTS OF $AL AND CONTENTS OF G AND PLACES THE RESULT IN $AL.

1L GA 096 0 B2 TL2 ,TABLE LOOKUP-DOUBLE LENGTH. 74 3
EXECUTES A LOOKUP ON A 2N WORD TABLE. WILL TEST FOLLOWING COND.
OF TABLE AGAINST PSEUDO ACC.
EQUAL,NOT EQUAL,NUMERIC HIGH,NUMERIC LOW.

1L KF 172 0 D2 DT2 ,DECIMAL TYPE-DOUBLE LENGTH. 208 6
CONVERTS DOUBLE PRECISION NUMBERS TO DECIMAL AND PRINTS
RESULT ON TYPEWRITER.

LOGRAMS - ALPHABETICAL INDEX

* Basic Logram Package
** Optional Arithmetic Package
Additional Lograms

P
PROGRAMS

A program can be defined as the sequential steps required to solve a given problem. Programs indexed in this catalog are assembled programs reduced to punched card and/or paper tape or magnetic tape form, coded in machine (or higher) language.

Programs which have been documented, but have not been subjected to thorough checkout, nor reduced to card or tape form, are descriptions of programs, and will be listed as Technical Manuals - Software (see H).

Programs available through the TRW Software Library are cataloged in the same manner as lograms, each classification being subdivided into sub-classifications to identify the program function. The codes used are those generally accepted and used in leading user's groups such as SHARE, CO-OP, etc.

NOTE: Programs are normally furnished on Punch Tape Mylar Blue Sandwich (5-level) RW Spec. 400951. MASS program is available on a punched-card deck, or may be issued on magnetic tape through special arrangements.

PROGRAM CLASSIFICATION AND SUB-CLASSIFICATION CODE

CLASSIFICATION
Sub-Classification

A PROGRAMMED ARITHMETIC
- A Real Fixed or Floating
- B Complex
- C Decimal-(BCD)

B ELEMENTARY FUNCTIONS
- A Trigonometric: Includes inverse trigonometric functions
- B Hyperbolic
- C Exponential and Logarithmic
- D Roots and Powers: Roots of quantities, not polynomials
- E RESERVED
- F Special

C POLYNOMIALS AND SPECIAL FUNCTIONS
- A Evaluation of Polynomials
- B Roots of Polynomials
- C Evaluation of Special Functions
- D Simultaneous Non-Linear Algebraic Equations
- E Simultaneous Transcendental Equations

D OPERATIONS ON FUNCTIONS AND SOLUTIONS OF DIFFERENTIAL EQUATIONS
- A Numerical Integration
- B Numerical Solutions of Ordinary Differential Equations
- C Numerical Solutions of Partial Differential Equations
- D Numerical Differentiation

E INTERPOLATION AND APPROXIMATIONS
- A Table Look-Up and Interpolation
- B Curve Fitting
- C Smoothing

F OPERATIONS ON MATRICES, VECTORS AND SIMULTANEOUS LINEAR EQUATIONS
- A Matric Operations
- B Eigenvalues and Eigenvectors
- C Determinants
- D Simultaneous Linear Equations

G STATISTICAL ANALYSIS AND PROBABILITY
- A Data Reduction: Interpreted as the calculation of the more common statistical parameters such as a mean, median standard, deviation, etc.
- B Correlation and Regression Analysis: Includes curve fitting for statistical purposes.
- C Sequential Analysis
- D Analysis of Variance
- E Random Number Generators

H OPERATIONS RESEARCH AND LINEAR PROGRAMMING

PROGRAM CLASSIFICATION AND SUB-CLASSIFICATION CODE (cont'd)

I INPUT SUB-CLASSES (Device must be specified)
- A Binary Load Routines
- B Octal Load Routines
- C Decimal Load Routines
- D Alphanumeric Load Routines
- E - Y RESERVED
- Z Special

J OUTPUT (Device must be specified)
- A Binary Output
- B Octal Output (Not standard dumps)
- C Decimal Output
- D Alphanumeric Output
- E Combinatorial
- F - Y RESERVED
- Z Special

K INTERNAL INFORMATION TRANSFER (to which the outside world does not have access)
- A Read-Write Auxiliary Storage (extend to main memory)
- B Relocation of Information (about the storage medium where it resides)
- C - Y RESERVED
- Z Special

L UTILITY ROUTINES
- A Assemblers
- B Compilers
- C Automatic Operator Programs: Refers to the monitoring routines used by installation which operates in the peripheral mode.

M INFORMATION PROCESSING
- A Sorting
- B Conversion: Includes only internal conversion from one mode to another, such as internal conversion from fixed to floating, with no input-output.
- C Collating and Merging
- D Table Look-Up
- E - Y RESERVED
- Z Special

N DEBUGGING ROUTINES
- A Tracing, Trapping
- B Dumps: Includes all output primarily intended for debugging purposes such as printout (on or off-line) of drums, tape, cores, and console.
- C Search: Searching (of tape, core, or drum) for debugging purposes is differential from table look-up.
- D Breakpoint Print (or snapshot dumping)

PROGRAM CLASSIFICATION AND SUB-CLASSIFICATION CODE (cont'd)

P DIAGNOSTIC PROGRAMS: Those which check for malfunctions of the hardware.

Q SERVICE PROGRAMS: Routines which perform a service for the programmer such as executing the equivalent of pushing a button on the computer or accumulating a checksum.

- A Clear Reset Programs
- B Checksum Programs
- C Restore, Rewind, Tape Mark, Load Button Programs

R RESERVED

S SIMULATION PROGRAMS: Programs that simulate a system, including other computer systems.

T - Y RESERVED

Z SPECIAL
All programs not covered in other classes or sub-classes.

*1P AA 084 0 B2 MP2SR ,MULTIPLY SUBROUTINE D.L. 27 2
MULTIPLIES DOUBLE LENGTH NUMBER IN $AL,$AR BY DOUBLE LENGTH NUMBER IN $T1,$T2. PRODUCT IS PLACED IN $AL,$AR.

*1P AA 085 0 B4 DV2SR ,DIVIDE SUBROUTINE D.L. 91
DIVIDES QUADRUPLE LENGTH NUMBER CONTAINED IN $AL,$AR,$QL,$QR BY DOUBLE LENGTH NUMBER CONTAINED IN $T1,$T2. QUOTIENT IS PLACED IN $AL,$AR.

*1P BA 080 0 B1 AT1SR ,ARCTANGENT SUBROUTINE S.L. 36
ARCTANGENT OF CONTENTS OF $AL IS PLACED IN $AL.

*1P BA 081 0 B2 AT2SR ,ARCTANGENT SUBROUTINE D.L. 107
ARCTANGENT OF DOUBLE LENGTH NUMBER CONTAINED IN $AL,$AR IS PLACED IN $AL,$AR.

*1P BD 082 0 B1 SR1SR ,SQUARE ROOT SUBROUTINE S.L. 50
SQUARE ROOT OF NUMBER IN $AL IS PLACED IN $T1.

*1P BD 083 0 B2 SR2SR ,SQUARE ROOT SUBROUTINE D.L. 75
SQUARE ROOT OF DOUBLE LENGTH NUMBER CONTAINED IN $AL,$AR IS PLACED IN $AL,$AR.

*1P BZ 079 0 B1 AT1TX ,ARCTANGENT TABLE S.L. 66
VALUES IN TABLE REPRESENT SINGLE LENGTH FRACTIONAL PARTS OF A RADIAN.

1P IA 089 0 ,BINARY LOADER (8 LEVEL).
LOADS A PROGRAM FROM PAPER TAPE WHICH IS PUNCHED IN 8 LEVEL BINARY FORMAT.

1P JA 090 0 ,BINARY PUNCH (8 LEVEL).
PUNCHES A PROGRAM ON PAPER TAPE IN 8 LEVEL BINARY FORMAT.

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1P LA 092 0          ,MASS ASSEMBLY PROGRAM TRW140 8K
                TRW130 SYMBOLIC ASSEMBLY PROGRAM,FOR USE IN ASSEMBLING TRW-130
                PROGRAMS ON IBM-7090,EXECUTION TO BE DONE ON EITHER IBM 7090
                OR ON TRW-130.

1P LA 108 0          TRW-130 ASSEMBLY PROGRAM.
                TRW130 SYMBOLIC ASSEMBLY PROGRAM. CONVERTS SYMBOLICALLY CODED
                TRW130 PROGRAMS INTO MACHINE LANGUAGE.

1P LA 108 1          TRW-130 ASSEMBLY PROGRAM-16 K.
                TRW130 SYMBOLIC ASSEMBLY PROGRAM. CONVERTS SYMBOLICALLY CODED
                TRW130 PROGRAMS INTO MACHINE LANGUAGE.

1P LC 106 0 B1       ,UPPER CORE LOADER.                    232
                PAPER TAPE PROGRAM LOADER. OCCUPIES  LOCATIONS 7725 THROUGH 7957.

1P LC 107 0 B1       ,LOWER CORE LOADER.                    232
                PAPER TAPE PROGRAM LOADER. OCCUPIES LOCATIONS 128 THROUGH 360.

1P LC 115 0          ,TRW-130 UTILITY PROGRAM (STANDARD CONFIGURATION)
                INPUT-OUTPUT PACKAGE CONTAINING FOLLOWING PROGRAMS-
                PROGRAM TAPE DUMP(PTD).
                KEYBOARD INPUT(KIP).
                MEMORY TYPEWRITER DUMP(MTD).

1P LC 116 0          ,TRW-130 UTILITY PROGRAM (FLEXOWRITER).
                INPUT-OUTPUT PACKAGE CONTAINING FOLLOWING PROGRAMS-
                MEMORY FLEXOWRITER DUMP(MFD).
                PAPER TAPE DUMP(PTD).
                KEYBOARD INPUT(KIP).

1P NA 156 0    OVNS  ,BRANCH ON OVERFLOW.                  2   12US
                ENTERED WHEN OVERFLOW IS DETECTED BY LOGRAMS IN OPTIONAL ARITHMETIC
                SET. EXECUTES A FLAG BRANCH TO THE ADDRESS CONTAINED IN $IC.
                COMPUTER STOPS IF IN FLAG MODE.

1P PA 099 0          ,C.S.C. DIAGNOSTIC FOR TRW-140 SYSTEM.
                DIAGNOSTIC PROGRAM FOR SC-100.
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1P PA 117 0          ,SYSTEM DIAGNOSTICS PROGRAM.
THE DIAGNOSTIC PROGRAM INCLUDES TESTS FOR THE FOLLOWING
BOOTSTRAP LOADER (WIRED IN BOOTSTRAP).
LOGAND LOGIC (MALFUNCTIONS WITHIN LOGAND CYCLE).
CORE MEMORY (MALFUNCTIONS IN CORE AND ASSOC. READ WRITE CIRC).
INPUT/OUTPUT (MALFUNCTIONS OF I/O EQUIPMENT).

1P PB 109 0          ,FLEXOWRITER ACCEPTANCE TEST.
TESTS TYPE-IN,TYPE-OUT, AND PUNCH (FLEXOWRITER).

1P PC 103 0          ,130 EXTENDED MEMORY DIAGNOSTICS
PERFORMS DIAGNOSTICS ON EXTENDED CORE MEMORY. PROGRAM INCLUDES
THE FOLLOWING-PRELIMINARY TEST,DELTA NOISE TEST,CIRCUIT NOISE
TEST,SENSE AMPLIFIER TEST,LOW FLUX TEST.

1P ZA 091 0          ,TIME KEEPER PROGRAM.                    61
DEMONSTRATION PROGRAM. COMPUTES CONTINUOUS RUNNING TIME IN
SECONDS AND DISPLAYS THE TIME IN THE A REGISTER.

*1P ZZ 086 0 N   HSK130,HOUSEKEEPING ROUTINE.                 42
STORES AND MODIFIES ENTRY ADDRESSES TO FOLLOWING ROUTINES-
AT1SR,AT2SR,SR1SR,SR2SR,MP2SR,DV2SR, ALSO INITILIZES $DK,$OV,$IC,
$ONE,$MON,$PFA,$PFB IN SCRATCHPAD AND CARRY,OVERFLOW,INTERRUPT
INDICATORS.
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S

APPLICATION STUDIES

Serial Number		
1SAA003	GREAT CIRCLE DISTANCES	M250-0U18

Solution of shortest distance between two points lying on a sphere. Applicable to computation of airline routes, missile trajectory, ship navigation and other related navigation programs.

1SAA005	VIDEO AMPLIFIER CALCULATION: GAIN BANDWIDTH PRODUCT	M250-0U20

A method of computing optimum amplifier design by building a table of GBW (gain band-width) products against which varying component values can be compared.

1SAA006	COORDINATE TRANSFORMATIONS	M250-1U12

Procedures for transforming typical coordinates (often necessary for processing radar and other data). Included are

Polar to Rectangular; Rectangular to Polar Spherical to Rectangular; Rectangular to Spherical; Geocentric to Rectangular; Rectangular to Geocentric.

1SAA007	MESSAGE FORMAT CONVERSION	M250-1U15

Program outline for converting message formats of two disparate electronic data control systems to message formats which can be transferred from one system to the other, using the TRW-130 as the translating intermediary.

1SAA008	AUTOMATIC AIRCRAFT VECTORING	M250-2U11

A program for computer-controlled positioning of aircraft in a predetermined path (or paths), by real-time computations updated at intervals of 100 ms. Three aircraft can be successfully vectored into their respective flight paths with one TRW-130 computer. Commands can be transmitted directly to the aircraft controllers for relay via a command control system or voice communication.

1SAA009	SHIPBOARD INSTRUMENTATION AND HEAD CORRECTION	M250-2U12

Data acquired by shipboard instruments must be corrected for variance caused by the ship's headway, roll, pitch, yaw and by the displacement of the instrumentation from the ship's axes of rotation. The calculation of these corrections is done in real-time, and is vital to underwater contour mapping, targeting with shipboard instruments, calculating ship position, and many other problems.

Serial Number

1SAA011 LONG RANGE HIGH PRECISION IMPACT PREDICTION — M250-2U13

The TRW-130 is used to derive a predicted point of impact for long range and orbital missiles and to continually monitor the missile in flight. The program may require additional operations described in other TRW application studies, i.e. "Coordinate Transformation", "Gray to Binary Conversion" and "Smoothing Position Data and Calculating Velocity Components" (the latter is in process as of 9-1-62).

1SAA012 COMPUTER SIMULATION — M25012U15

Study illustrates simulation on the TRW-130 of other computers (Royal McBee LGP-30 and Bendix G15, in this study). It is shown that LGP-30 and G15 programs can operate substantially faster if run on the TRW-130 under simulation.

1SAA013 GRAY TO BINARY CONVERSION — M250-2U14

Two methods of converting Gray code to Binary are described. The serial method requires minimum storage area, but longer execution time than the Table Look-Up method, which conserves execution time but requires approximately double cell storage area.

1SAA004 UNIT COST METHOD OF EVALUATING A MACHINE — M250-0U19

A method of evaluating competitive equipment (old vs. new, new vs. new, etc.) by calculating the value of unit productivity related to machine initial cost, depreciation, maintenance and salvage values. A more decisive evaluation of equipment is obtained than with the depreciation accounting method.

1SAA014 PULSE - WIDTH MODULATION TELEMETRY — M250-2U31

TRW-130 techniques yield improved performance for telemetry systems using Pulse Width or Pulse Duration Modulation methods. Assistance of the computer is suggested as a bridge between conversion from PWM or DPM methods to newer modulation methods now being developed.

Serial Number		
1SAA015	CALCULATION OF THE LINE OF POSITION AT SEA	M250-2U30

Rapid calculation (.10 second) of line of position at sea is achieved with TRW-130. Accuracy is improved, and a "best-fix" is based on many independent calculations impractical with manual methods.

1SAA016	AUTOMATIC MAP COMPILATION WITH THE AID OF A TRW-130 DIGITAL COMPUTER	M250-3U4

Topographic maps are prepared using raw data from aerial photographs. Data is reduced by analog and digital techniques with a TRW Automatic Map Compilation System and a TRW-130 Digital Computer. A high compilation rate is achieved with a modest-size computer and analog equipment of fairly low accuracy except for the position encoders, which provide high accuracy position data to the computer. The study indicates that very complex areas(5"x9") can be compiled in a little over one hour, while simpler areas permitting larger spacing between successive points of measurement would be covered in perhaps half an hour.

1SAA017	LORAN C POSITION COMPUTATION	M250-2U45

Loran C is capable of measuring to a fraction of a micro-second the difference in time of arrival of two synchronized signals. A precise position (within 100 feet at 1000 miles) is generated by the TRW-130 in less than one second.

1SAA-18	REAL-TIME SONAR DATA PROCESSING	M250-3U3

Sonar data is processed by the TRW-130 rapidly and accurately enough to locate underwater targets. Each sonar return must be adjusted for ray bend. Terminal target coordinates are "matched", using real-time data and pre-computed two-dimensional value tables.

1SAA019	RADAR ACQUISITION AND TRACKING	M250-2U40

Radar data referencing the position of a missile is evaluated by the TRW-130 at a series of missile range sites. Acquisition includes analysis of incoming data for the purpose of setting the radar on track, calculation of cartesian data, and data output for map plotting. Some of the objectives of the tracking functions are to convert data to cartesian form referenced to the local site, determine the appropriate downrange site to which transmission will be made, and transmit a predicted flight path to the downrange site. Data are also output to a central computer site.