

**UNIVAC SCIENTIFIC  
GENERAL-PURPOSE COMPUTER  
SYSTEM  
CONTENT OF REGISTERS**

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DIVISION OF SPERRY RAND CORPORATION

# CONTENT OF REGISTERS

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## CONTENT OF REGISTERS

### 1. GENERAL.

This volume is a tabulation of the final contents of the memory locations, the Q Register and the Accumulator, after the execution of each instruction. The instruction tables are listed in the numerical order of their octal operation codes. The left column, STORAGE CLASS SELECTION, lists the class of storage chosen for the u address and v address. The remainder of the table lists the final contents of MC, MD, A, and Q for all cases of storage class selections. Those instructions which do not result in changes contain no tables but, instead, have notes covering these exceptions. A series of dashes in any table position indicate that the memory location or register is not involved in the execution of the instruction. An SCC table entry indicates that an SCC Fault occurs causing the computer to stop.

### 2. DEFINITION OF SYMBOLS.

A	The 72-bit Accumulator
AR	The right-hand 36 bits of A
A <sub>L</sub>	The left-hand 36 bits of A
Q	The 36-bit Q Register
MD	Magnetic Drum Storage (16,384 36-bit words)
MC	Magnetic Core Storage (4096 36-bit words)
u	The first execution address ( $i_{29}, i_{28}, \dots, i_{15}$ )
v	The second execution address ( $i_{14}, i_{13}, \dots, i_0$ )
.2 <sup>k</sup>	Left circular shift k places
( )	(Parentheses) Denotes "the content of"
( ) <sub>i</sub>	The "initial content of"
( ) <sub>f</sub>	The "final content of"
( )'	(Prime) The "complement of the content of"

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$  ( )  $	The absolute value of the expression
j	A one digit octal number ( $u_{14}, u_{13}, u_{12}$ )
n	A four digit octal number ( $u_{11}, u_{10}, \dots, u_0$ )
D( )	A double extension of the contents of the parentheses
S( )	A single extension of the contents of the parentheses
$L(Q)(u)$	The bit-by-bit product of (u) and (Q)
$L(Q)'(v)$	The bit-by-bit product of (v) and the complement of (Q)
$\oplus$	Denotes a bit-by-bit sum without carries.

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Instruction: TRANSMIT POSITIVE (TPuv)				Operation Code: 11	
Function: Replace (v) with (u).					
Storage Class Selection		Content of Registers and Storage Positions after Operation is Executed.			
		(MC) <sub>f</sub> or (MD) <sub>f</sub>		(A) <sub>f</sub>	(Q) <sub>f</sub>
u	v	u	v		
MC or MD	MC or MD	No Change	(u)	- - -	- - -
	A	No Change	- - -	D(u)	- - -
	Q	No Change	- - -	- - -	(u)
A	MC or MD	- - -	(A <sub>R</sub> )	No Change	- - -
	A	- - -	- - -	D(A <sub>R</sub> ) <sub>i</sub>	- - -
	Q	- - -	- - -	No Change	(A <sub>R</sub> )
Q	MC or MD	- - -	(Q)	- - -	No Change
	A	- - -	- - -	D(Q)	No Change
	Q	- - -	- - -	- - -	No Change

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Instruction: TRANSMIT MAGNITUDE (TMuv)				Operation Code: 12	
Function: Replace (v) with the absolute magnitude of (u).					
Storage Class Selection		Content of Registers and Storage Positions after Operation is Executed.			
		(MC) <sub>f</sub> or (MD) <sub>f</sub>		(A) <sub>f</sub>	(Q) <sub>f</sub>
u	v	u	v		
MC or MD	MC or MD	No Change	$\left  (u) \right $	- - -	- - -
	A	No Change	- - -	D $\left  (u) \right $	- - -
	Q	No Change	- - -	- - -	$\left  (u) \right $
A	MC or MD	- - -	$\left  (A_R) \right $	No Change	- - -
	A	- - -	- - -	D $\left  (A_R)_i \right $	- - -
	Q	- - -	- - -	No Change	$\left  (A_R) \right $
Q	MC or MD	- - -	$\left  (Q) \right $	- - -	No Change
	A	- - -	- - -	D $\left  (Q) \right $	No Change
	Q	- - -	- - -	- - -	$\left  (Q)_i \right $

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Instruction: TRANSMIT NEGATIVE (TNUv)				Operation Code: 13	
Function: Replace (v) with the complement of (u).					
Storage Class Selection		Content of Registers and Storage Positions after Operation is Executed.			
		(MC) <sub>f</sub> or(MD) <sub>f</sub>		(A) <sub>f</sub>	(Q) <sub>F</sub>
u	v	u	v		
MC or MD	MC or MD	No Change	(u)'	- - -	- - -
	A	No Change	- - -	D(u)'	- - -
	Q	No Change	- - -	- - -	(u)'
A	MC or MD	- - -	(A <sub>R</sub> )'	No Change	- - -
	A	- - -	- - -	D(A <sub>R</sub> ) <sub>i</sub> '	- - -
	Q	- - -	- - -	No Change	(A <sub>R</sub> )'
Q	MC or MD	- - -	(Q)'	- - -	No Change
	A	- - -	- - -	D(Q)'	No Change
	Q	- - -	- - -	- - -	(Q) <sub>i</sub> '

# CONTENT OF REGISTERS

Instruction: INTERPRET (IP--)	Operation Code: 14
<p>Function: Let <math>y</math> represent the address from which CI was obtained.</p> <p>Replace the right-hand 15 bits of (<math>F_1</math>) with the quantity <math>y + 1</math>. Then take (<math>F_2</math>) as the next instruction.</p> <p><math>F_1</math> and <math>F_2</math> are MC addresses 00000 and 00001 respectively.</p> <p>The right-hand 30 bits of (<math>y</math>) are unaffected by this operation. The contents of A and Q are left unchanged.</p>	



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Instruction: TRANSMIT U ADDRESS (TUuv)				Operation Code: 15	
Function: Replace the 15 bits of (v) designated v <sub>15</sub> through v <sub>29</sub> with the corresponding bits of (u). The remaining 21 bits of (v) are not to be disturbed.					
Storage Class Selection		Content of Registers and Storage Positions after Operation is Executed.			
		(MC) <sub>f</sub> or (MD) <sub>f</sub>		(A) <sub>f</sub>	(Q) <sub>f</sub>
u	v	u	v		
MC or MD	MC or MD	} No Change	{ (v <sub>0-14</sub> ) <sub>i</sub> (u <sub>15-29</sub> ) (v <sub>30-35</sub> ) <sub>i</sub> SCC FAULT	---	---
	A				
	Q				
A	MC or MD	} ---	{ (v <sub>0-14</sub> ) <sub>i</sub> (A <sub>15-29</sub> ) (v <sub>30-35</sub> ) <sub>i</sub> SCC FAULT	No Change	---
	A				
	Q				
Q	MC or MD	} ---	{ (v <sub>0-14</sub> ) <sub>i</sub> (Q <sub>15-29</sub> ) (v <sub>30-35</sub> ) <sub>i</sub> SCC FAULT	---	No Change
	A				
	Q				
SCC FAULT					

# CONTENT OF REGISTERS

Instruction: TRANSMIT V ADDRESS (TVuv)				Operation Code: 16	
Function: Replace the right-hand 15 bits of (v), v <sub>0</sub> through v <sub>14</sub> , with the corresponding bits of (u). The remaining 21 bits of (v) are not to be disturbed.					
Storage Class Selection		Content of Registers and Storage Positions after Operation is Executed.			
		(MC) <sub>f</sub> or (MD) <sub>f</sub>		(A) <sub>f</sub>	(Q) <sub>f</sub>
u	v	u	v		
MC or MD	MC	} SCC FAULT	(u <sub>0-14</sub> )	- - -	- - -
	or MD		(v <sub>15-35</sub> ) <sub>i</sub>		
	A				
	Q				
A	MC	} SCC FAULT	(A <sub>0-14</sub> )	No Change	- - -
	or MD		(v <sub>15-35</sub> ) <sub>i</sub>		
	A				
	Q				
Q	MC	} SCC FAULT	(Q <sub>0-14</sub> )	- - -	No Change
	or MD		(v <sub>15-35</sub> ) <sub>i</sub>		
	A				
	Q				

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Instruction: EXTERNAL FUNCTION (EF-v)	Operation Code: 17
Function: Select a unit of external equipment and perform the function designated by (v).	
(No Change in Content of Registers)	

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Instruction: REPLACE ADD (RAuv)				Operation Code: 21	
Function: Form in A the sum of D(u) and D(v). Then replace (u) with (A <sub>R</sub> ).					
Storage Class Selection		Content of Registers and Storage Positions after Operation is Executed			
		(MC) <sub>f</sub> or (MD) <sub>f</sub>		(A) <sub>f</sub>	(Q) <sub>f</sub>
u	v	u	v		
MC or MD	MC or MD	(A <sub>R</sub> ) <sub>f</sub>	No Change	D(u) <sub>i</sub> +D(v)	- - -
	A	(A <sub>R</sub> ) <sub>f</sub>	- - -	2D(u)	- - -
	Q	(A <sub>R</sub> ) <sub>f</sub>	- - -	D(u) <sub>i</sub> +D(Q)	No Change
A	MC or MD	- - -	No Change	D(A <sub>R</sub> ) <sub>i</sub> +D(v)	- - -
	A	- - -	- - -	2D(A <sub>R</sub> ) <sub>i</sub>	- - -
	Q	- - -	- - -	D(A <sub>R</sub> ) <sub>i</sub> +D(Q)	No Change
Q	MC or MD	- - -	No Change	D(Q) <sub>i</sub> +D(v)	(A <sub>R</sub> ) <sub>f</sub>
	A	- - -	- - -	2D(Q)	(A <sub>R</sub> ) <sub>f</sub>
	Q	- - -	- - -	2D(Q) <sub>i</sub>	(A <sub>R</sub> ) <sub>f</sub>

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Instruction: LEFT TRANSMIT (LTj <sub>k</sub> v)		Operation Code: 22	
Function: Left circular shift (A) by k places. Then replace  (v) with (A <sub>L</sub> ) if j=0, or replace (v) with (A <sub>R</sub> )  if j=1.			
Storage Class Selection for v	Content of Registers and Storage Positions after Operation is Executed		
	(MC) <sub>f</sub> or (MD) <sub>f</sub>	(A) <sub>f</sub>	(Q) <sub>f</sub>

j=0

MC or MD	(A <sub>L</sub> ) <sub>f</sub>	(A) <sub>i</sub> · 2 <sup>k</sup>	- - -
A	- - -	D(A <sub>L</sub> ) <sub>k</sub> where (A) <sub>k</sub> is (A) <sub>i</sub> · 2 <sup>k</sup>	
Q	- - -	(A) <sub>i</sub> · 2 <sup>k</sup>	(A <sub>L</sub> ) <sub>f</sub>

j=1

MC or MD	(A <sub>R</sub> ) <sub>f</sub>	(A) <sub>i</sub> · 2 <sup>k</sup>	- - -
A	- - -	D(A <sub>R</sub> ) <sub>k</sub> where (A) <sub>k</sub> is (A) <sub>i</sub> · 2 <sup>k</sup>	- - -
Q	- - -	(A) <sub>i</sub> · 2 <sup>k</sup>	(A <sub>R</sub> ) <sub>f</sub>

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Instruction: REPLACE SUBTRACT (RSuv)				Operation Code: 23	
Function: Form in A the difference D(u) minus D(v). Then replace (u) with (A <sub>R</sub> ).					
Storage Class Selection		Content of Registers and Storage Positions after Operation is Executed.			
		(MC) <sub>f</sub> or (MD) <sub>f</sub>		(A) <sub>f</sub>	(Q) <sub>f</sub>
u	v	u	v		
MC or MD	MC or MD	(A <sub>R</sub> ) <sub>f</sub>	No Change	D(u) <sub>i</sub> -D(v)	- - -
	A	0	- - -	0	- - -
	Q	(A <sub>R</sub> ) <sub>f</sub>	- - -	D(u) <sub>i</sub> -D(Q)	No Change
A	MC or MD	- - -	No Change	D(A <sub>R</sub> ) <sub>i</sub> -D(v)	- - -
	A	- - -	- - -	0	- - -
	Q	- - -	- - -	D(A <sub>R</sub> ) <sub>i</sub> -D(Q)	No Change
Q	MC or MD	- - -	No Change	D(Q) <sub>i</sub> -D(v)	(A <sub>R</sub> ) <sub>f</sub>
	A	- - -	- - -	0	0
	Q	- - -	- - -	0	0

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Instruction: CONTROLLED COMPLEMENT (CCuv)					Operation Code: 27	
Function: Replace (A <sub>R</sub> ) with (u) leaving (A <sub>L</sub> ) undisturbed. Then complement those bits of (A <sub>R</sub> ) that correspond to ones in (v). Then replace (u) with (A <sub>R</sub> ).						
Storage Class Selection		Content of Registers and Storage Positions after Operation is Executed				
		(MC) <sub>f</sub> or (MD) <sub>f</sub>		(A <sub>L</sub> ) <sub>f</sub>	(A <sub>R</sub> ) <sub>f</sub>	(Q) <sub>f</sub>
u	v	u	v			
MC or MD	MC or MD	(A <sub>R</sub> ) <sub>f</sub>	No Change	No Change	(u) <sub>i</sub> ⊕ (v)	- - -
	A	(A <sub>R</sub> ) <sub>f</sub>	- - -	No Change	Zero	- - -
	Q	(A <sub>R</sub> ) <sub>f</sub>	- - -	No Change	(u) <sub>i</sub> ⊕ (Q)	No Change
A	MC or MD	- - -	No Change	No Change	(A <sub>R</sub> ) <sub>i</sub> ⊕ (v)	- - -
	A	- - -	- - -	No Change	Zero	- - -
	Q	- - -	- - -	No Change	(A <sub>R</sub> ) <sub>i</sub> ⊕ (Q)	No Change
Q	MC or MD	- - -	No Change	No Change	(Q) <sub>i</sub> ⊕ (v)	(A <sub>R</sub> ) <sub>f</sub>
	A	- - -	- - -	No Change	Zero	Zero
	Q	- - -	- - -	No Change	Zero	(A <sub>R</sub> ) <sub>f</sub>

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Instruction: SPLIT POSITIVE ENTRY (SPuk)		Operation Code: 31	
Function: Form S(u) in A. Then left circular shift (A) by k places.			
Storage Class Selection for u	Content of Registers and Storage Positions after Operation is Executed.		
	(MC) <sub>f</sub> or (MD) <sub>f</sub>	(A) <sub>f</sub>	(Q) <sub>f</sub>
MC or MD	No Change	S(u) · 2 <sup>k</sup>	- - -
A	- - -	S(A <sub>R</sub> ) <sub>i</sub> · 2 <sup>k</sup>	- - -
Q	- - -	S(Q) · 2 <sup>k</sup>	No Change

Instruction: SPLIT ADD (SAuk)		Operation Code: 32	
Function: Add S(u) to A. Then left circular shift (A) by k places			
Storage Class Selection for u	Content of Registers and Storage Positions after Operation is Executed.		
	(MC) <sub>f</sub> or (MD) <sub>f</sub>	(A) <sub>f</sub>	(Q) <sub>f</sub>
MC or MD	No Change	$\left[ (A)_i + S(u) \right] \cdot 2^k$	- - -
A	- - -	$\left[ (A)_i + S(A_R)_i \right] \cdot 2^k$	- - -
Q	- - -	$\left[ (A)_i + S(Q) \right] \cdot 2^k$	No Change



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Instruction: SPLIT NEGATIVE ENTRY (SNuk)		Operation Code: 33	
Function: Form in A the complement of S(u). Then left circular shift (A) by k places.			
Storage Class Selection for u	Content of Registers and Storage Positions after Operation is Executed.		
	(MC) <sub>f</sub> or (MD) <sub>f</sub>	(A) <sub>f</sub>	(Q) <sub>f</sub>
MC or MD	No Change	S(u)' · 2 <sup>k</sup>	- - -
A	- - -	S(A <sub>R</sub> ) <sub>i</sub> ' · 2 <sup>k</sup>	- - -
Q	- - -	S(Q)' · 2 <sup>k</sup>	No Change

Instruction: SPLIT SUBTRACT (SSuk)		Operation Code: 34	
Function: Subtract S(u) from A. Then left circular shift (A) by k places.			
Storage Class Selection for u	Content of Registers and Storage Positions after Operation is Executed.		
	(MC) <sub>f</sub> or (MD) <sub>f</sub>	(A) <sub>f</sub>	(Q) <sub>f</sub>
MC or MD	No Change	$\left[ (A)_i - S(u) \right] \cdot 2^k$	- - -
A	- - -	$\left[ (A)_i - S(A_R)_i \right] \cdot 2^k$	- - -
Q	- - -	$\left[ (A)_i - S(Q) \right] \cdot 2^k$	No Change

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Instruction: ADD AND TRANSMIT (ATuv)				Operation Code: 35	
Function: Add D(u) to (A). Then replace (v) with (A <sub>R</sub> ).					
Storage Class Selection		Content of Registers and Storage Positions after Operation is Executed.			
		(MC) <sub>f</sub> or (MD) <sub>f</sub>		(A) <sub>f</sub>	(Q) <sub>f</sub>
u	v	u	v		
MC or MD	MC or MD	No Change	(A <sub>R</sub> ) <sub>f</sub>	(A) <sub>i</sub> +D(u)	- - -
	A	No Change	- - -	(A) <sub>i</sub> +D(u)	- - -
	Q	No Change	- - -	(A) <sub>i</sub> +D(u)	(A <sub>R</sub> ) <sub>f</sub>
A	MC or MD	- - -	(A <sub>R</sub> ) <sub>f</sub>	(A) <sub>i</sub> +D(A <sub>R</sub> ) <sub>i</sub>	- - -
	A	- - -	- - -	(A) <sub>i</sub> +D(A <sub>R</sub> ) <sub>i</sub>	- - -
	Q	- - -	- - -	(A) <sub>i</sub> +D(A <sub>R</sub> ) <sub>i</sub>	(A <sub>R</sub> ) <sub>f</sub>
Q	MC or MD	- - -	(A <sub>R</sub> ) <sub>f</sub>	(A) <sub>i</sub> + D(Q)	No Change
	A	- - -	- - -	(A) <sub>i</sub> + D(Q)	No Change
	Q	- - -	- - -	(A) <sub>i</sub> +D(Q) <sub>i</sub>	(A <sub>R</sub> ) <sub>f</sub>

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Instruction: SUBTRACT AND TRANSMIT (STuv)				Operation Code: 36	
Function: Subtract D(u) from (A). Then replace (v) with (A <sub>R</sub> ).					
Storage Class Selection		Content of Registers and Storage Positions after Operation is Executed.			
		(MC) <sub>f</sub> or (MD) <sub>f</sub>		(A) <sub>f</sub>	(Q) <sub>f</sub>
u	v	u	v		
MC or MD	MC or MD	No Change	(A <sub>R</sub> ) <sub>f</sub>	(A) <sub>i</sub> -D(u)	- - -
	A	No Change	- - -	(A) <sub>i</sub> -D(u)	- - -
	Q	No Change	- - -	(A) <sub>i</sub> -D(u)	(A <sub>R</sub> ) <sub>f</sub>
A	MC or MD	- - -	(A <sub>R</sub> ) <sub>f</sub>	(A) <sub>i</sub> -D(A <sub>R</sub> ) <sub>i</sub>	- - -
	A	- - -	- - -	(A) <sub>i</sub> -D(A <sub>R</sub> ) <sub>i</sub>	- - -
	Q	- - -	- - -	(A) <sub>i</sub> -D(A <sub>R</sub> ) <sub>i</sub>	(A <sub>R</sub> ) <sub>f</sub>
Q	MC or MD	- - -	(A <sub>R</sub> ) <sub>f</sub>	(A) <sub>i</sub> -D(Q)	No Change
	A	- - -	- - -	(A) <sub>i</sub> -D(Q)	No Change
	Q	- - -	- - -	(A) <sub>i</sub> -D(Q) <sub>i</sub>	(A <sub>R</sub> ) <sub>f</sub>

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Instruction: RETURN JUMP (RJuv)	Operation Code: 37
<p>Function      Let y represent the address from which CI was obtained.</p> <p>                Replace the right-hand 15 bits of (u) with quantity y</p> <p>                plus 1. Then take (v) as NI.</p> <p>                (If both u and v refer to MC or MD there is no change in contents</p> <p>                of A and Q. If u is Q or A, an SCC FAULT occurs. Also see</p> <p>                page 24.)</p>	

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Instruction: INDEX JUMP (IJuv)				Operation Code: 41	
Function: Form in A the difference D(u) minus 1. If A <sub>71</sub> is then 1, continue with the present sequence of instructions; if A <sub>71</sub> is 0, replace (u) with (A <sub>R</sub> ) and take (v) as the next instruction.					
Storage Class Selection		Content of Registers and Storage Positions after Operation is Executed.			
		(MC) <sub>f</sub> or (MD) <sub>f</sub>		(A) <sub>f</sub>	(Q) <sub>f</sub>
u	v	u	v		
FOR A <sub>71</sub> = 1					
MC or MD	MC or MD	No Change	No Change	D(u)-1	- - -
	A*	No Change	- - -	D(u)-1	- - -
	Q*	No Change	- - -	D(u)-1	No Change
A	MC or MD	- - -	No Change	(A) <sub>i</sub> -1	- - -
	A*	- - -	- - -	(A) <sub>i</sub> -1	- - -
	Q*	- - -	- - -	(A) <sub>i</sub> -1	No Change
Q	MC or MD	- - -	No Change	D(Q)-1	No Change
	A*	- - -	- - -	D(Q)-1	No Change
	Q*	- - -	- - -	D(Q)-1	No Change

\* see page 24

# CONTENT OF REGISTERS

INDEX JUMP (IJuv) continued

Storage Class Selection		Content of Registers and Storage Positions after Operation is Executed.			
		$(MC)_f$ or $(MD)_f$		$(A)_f$	$(Q)_f$
u	v	u	v		
FOR $A_{71} = 0$					
MC or MD	MC or MD	$(u)_{i-1}$	No Change	$D(u)_{i-1}$	- - -
	A*	$(u)_{i-1}$	- - -	$D(u)_{i-1}$	- - -
	Q*	$(u)_{i-1}$	- - -	$D(u)_{i-1}$	No Change
A	MC or MD	- - -	No Change	$(A)_{i-1}$	- - -
	A*	- - -	- - -	$(A)_{i-1}$	- - -
	Q*	- - -	- - -	$(A)_{i-1}$	No Change
Q	MC or MD	- - -	No Change	$D(Q)_{i-1}$	$(Q)_{i-1}$
	A*	- - -	- - -	$D(Q)_{i-1}$	$(Q)_{i-1}$
	Q*	- - -	- - -	$D(Q)_{i-1}$	$(Q)_{i-1}$

\* see page 24

# CONTENT OF REGISTERS

Instruction: THRESHOLD JUMP (TJuv)	Operation Code: 42
<p>Function: Subtract (u) from (A). If <math>A_{71}</math> is then 1, take (v) as the next instruction; if <math>A_{71}</math> is 0, continue with the present sequence of instructions. Then, in either case, restore (A) to its initial state.</p> <p>(No change in Content of Registers or Storage Positions except for those special cases outlined on pages 24 and 35.)</p>	

Instruction: EQUALITY JUMP (EJuv)	Operation Code: 43
<p>Function: Subtract (u) from (A). If (A) is then zero, take (v) as the next instruction; if (A) is not zero, continue with the present sequence of instructions. In either case restore (A) to its initial state.</p> <p>(No Change in Content of Registers or Storage Positions except for those special cases outlined on pages 24 and 35.)</p>	

# CONTENT OF REGISTERS

Instruction: Q-JUMP (QJuv)				Operation Code: 44	
Function: If Q <sub>35</sub> is 1, take (u) as the next instruction; if Q <sub>35</sub> is 0, take (v) as the next instruction. Then, in either case, left circular shift (Q) by one place.					
Storage Class Selection		Content of Registers and Storage Position after Operation is Executed.			
		(MC) <sub>f</sub> or (MD) <sub>f</sub>		(A) <sub>f</sub>	(Q) <sub>f</sub>
u	v	u	v		
MC or MD	MC or MD	No Change	No Change	- - -	(Q) <sub>i</sub> · 2
	A*	No Change	- - -	No Change	(Q) <sub>i</sub> · 2
	Q*	No Change	- - -	- - -	(Q) <sub>i</sub> · 2
A	MC or MD	- - -	No Change	No Change	(Q) <sub>i</sub> · 2
	A*	- - -	- - -	No Change	(Q) <sub>i</sub> · 2
	Q*	- - -	- - -	No Change	(Q) <sub>i</sub> · 2
Q	MC or MD	- - -	No Change	- - -	(Q) <sub>i</sub> · 2
	A*	- - -	- - -	No Change	(Q) <sub>i</sub> · 2
	Q*	- - -	- - -	- - -	(Q) <sub>i</sub> · 2

\* see page 24



# CONTENT OF REGISTERS

Instruction: MANUALLY SELECTIVE JUMP (MJjv)	Operation Code: 45
<p>Function: If the number j(given by u<sub>13</sub> u<sub>12</sub>) is 0, take (v) as the next instruction. If j is 1, 2 or 3 and the correspondingly numbered manual jump-selecting switch is set to "jump", take (v) as the next instruction; otherwise if this switch is not set to "jump", continue with the present sequence of instruction.</p> <p>(No Change in Content of Registers or Storage Positions and see page 24.)</p>	
Instruction: SIGN JUMP (SJuv)	Operation Code: 46
<p>Function: If A<sub>71</sub> is 1, take (u) as the next instruction. If A<sub>71</sub> is 0, take (v) as the next instruction.</p> <p>(No Change in Content of Registers or Storage Positions and see page 24.)</p>	
Instruction: ZERO JUMP (ZJuv)	Operation Code: 47
<p>Function: If (A) <u>is not</u> zero, take (u) as the next instruction; if (A) <u>is</u> zero, take (v) as the next instruction. In either case leave (A) in its initial state.</p> <p>(No Changes in Content of Registers or Storage Positions and see page 24.)</p>	

## CONTENT OF REGISTERS

### Notes Concerning the Jump Instructions

1. If v refers to A, an SCC FAULT occurs.
2. If v refers to Q, no fault occurs, and Control obtains the NI from (Q).  
If the (Q) is a legal instruction, it will be executed in the normal manner. Unless (Q) is a jump instruction, however, the following will occur: (1) PAK will be advanced and the (Q) will be taken as NI;  
(2) Control will be directed to Q again after executing the (Q), PAK will be advanced, and (Q) executed again. This process will continue until a FORCE stop is made. PAK advances from 31000 to 31777 and then starts over from 31000, each time, of course, referencing Q as the address of NI.
3. The above remarks also apply to u for the two way jump instruction, QJ, SJ, and ZJ.

# CONTENT OF REGISTERS

Instruction : Q-CONTROLLED TRANSMIT (QTuv)				Operation Code: 51	
Function: Form in A the number L(Q)(u). Then replace (v) by (A <sub>R</sub> ).					
Storage Class Selection		Content of Registers and Storage Positions after Operation is Executed.			
		(MC) <sub>f</sub> or (MD) <sub>f</sub> See Storage Class Selection		(A) <sub>f</sub>	(Q) <sub>f</sub>
u	v	u	v		
MC or MD	MC or MD	No Change	(A <sub>R</sub> ) <sub>f</sub>	L(Q)(u)	No Change
	A	No Change	- - -	L(Q)(u)	No Change
	Q	No Change	- - -	L(Q)(u)	(A <sub>R</sub> ) <sub>f</sub>
A	MC or MD	- - -	(A <sub>R</sub> ) <sub>f</sub>	L(Q) (A <sub>R</sub> ) <sub>i</sub>	No Change
	A	- - -	- - -	L(Q) (A <sub>R</sub> ) <sub>i</sub>	No Change
	Q	- - -	- - -	L(Q) (A <sub>R</sub> ) <sub>i</sub>	(A <sub>R</sub> ) <sub>f</sub>
Q	MC or MD	- - -	(Q)	S(Q)	No Change
	A	- - -	- - -	S(Q)	No Change
	Q	- - -	- - -	S(Q)	No Change

# CONTENT OF REGISTERS

Instruction: Q-CONTROLLED ADD(QAuv)				Operation Code: 52	
Function: Add to (A) the number L(Q)(u). Then replace (v) by (A <sub>R</sub> ).					
Storage Class Selection		Content of Registers and Storage Positions after Operation is Executed.			
		(MC) <sub>f</sub> or (MD) <sub>f</sub> See Storage Class Selection		(A) <sub>f</sub>	(Q) <sub>f</sub>
		u	v		
MC or MD	MC or MD	No Change	(A <sub>R</sub> ) <sub>f</sub>	(A) <sub>i</sub> + L(Q)(u)	No Change
	A	No Change	- - -	(A) <sub>i</sub> + L(Q)(u)	No Change
	Q	No Change	- - -	(A) <sub>i</sub> + L(Q)(u)	(A <sub>R</sub> ) <sub>f</sub>
A	MC or MD	- - -	(A <sub>R</sub> ) <sub>f</sub>	(A) <sub>i</sub> + L(Q)(A <sub>R</sub> ) <sub>i</sub>	No Change
	A	- - -	- - -	(A) <sub>i</sub> + L(Q)(A <sub>R</sub> ) <sub>i</sub>	No Change
	Q	- - -	- - -	(A) <sub>i</sub> + L(Q)(A <sub>R</sub> ) <sub>i</sub>	(A <sub>R</sub> ) <sub>f</sub>
Q	MC or MD	- - -	(A <sub>R</sub> ) <sub>f</sub>	(A) <sub>i</sub> +S(Q)	No Change
	A	- - -	- - -	(A) <sub>i</sub> +S(Q)	No Change
	Q	- - -	- - -	(A) <sub>i</sub> +S(Q)	(A <sub>R</sub> ) <sub>f</sub>

# CONTENT OF REGISTERS

Instruction: Q-CONTROLLED SUBSTITUTE (QSuv)				Operation Code: 53	
Function : Form in A the quantity $L(Q)(u)+L(Q)'(v)$ ; then replace (v) with $A_R$ . (The effect of this is to replace the digits of (v) with the digits of (u) where there are 1's in Q.)					
Storage Class Selection		Content of Registers and Storage Positions after Operation is Executed.			
		$(MC)_f$ or $(MD)_f$		$(A)_f$	$(Q)_f$
u	v	u	v		
MC or MD	MC or MD	No Change	$(A_R)_f$	$L(Q)(u)+L(Q)'(v)$	No Change
	A	No Change	- - -	$L(Q)(u)$	No Change
	Q	No Change	- - -	$L(Q)(u)+S(Q)'$	$(A_R)_f$
A	MC or MD	- - -	$(A_R)_f$	$L(Q)(A_R)_i+L(Q)'(v)$	No Change
	A	- - -	- - -	$L(Q)(A_R)_i$	No Change
	Q	- - -	- - -	$L(Q)(A_R)_i + S(Q)'$	$(A_R)_f$
Q	MC or MD	- - -	$(A_R)_f$	$S(Q)+L(Q)'(v)$	No Change
	A	- - -	- - -	$S(Q)$	No Change
	Q	- - -	- - -	$2^{36}_{-1}$	$2^{36}_{-1}$

# CONTENT OF REGISTERS

Instruction: LEFT SHIFT IN A (LAuk)		Operation Code: 54	
Function: Replace (A) with D(u); then left circular shift (A) by k places; then replace (u) with (A <sub>R</sub> ).			
Storage Class Selection for u	Content of Registers and Storage Positions after Operation is Executed.		
	(MC) <sub>f</sub> or (MD) <sub>f</sub>	(A) <sub>f</sub>	(Q) <sub>f</sub>
MC or MD	(A <sub>R</sub> ) <sub>f</sub>	D(u) <sub>i</sub> · 2 <sup>k</sup>	- - -
A	- - -	(A) <sub>i</sub> · 2 <sup>k</sup>	- - -
Q	- - -	D(Q) <sub>i</sub> · 2 <sup>k</sup>	(A <sub>R</sub> ) <sub>f</sub>

Instruction: LEFT SHIFT IN Q (LQuk)		Operation Code: 55	
Function: Replace (Q) with (u); then left circular shift (Q) by k places; then replace (u) with (Q).			
Storage Class Selection for u	Content of Registers and Storage Positions after Operation is Executed.		
	(MC) <sub>f</sub> or (MD) <sub>f</sub>	(A) <sub>f</sub>	(Q) <sub>f</sub>
MC or MD	(u) <sub>i</sub> · 2 <sup>k</sup>	- - -	(u) <sub>i</sub> · 2 <sup>k</sup>
A	- - -	D(Q) <sub>f</sub>	(A <sub>R</sub> ) <sub>i</sub> · 2 <sup>k</sup>
Q	- - -	- - -	(Q) <sub>i</sub> · 2 <sup>k</sup>

# CONTENT OF REGISTERS

Instruction: MANUALLY SELECTIVE STOP (MSjv)	Operation Code: 56
<p data-bbox="302 268 1502 625">Function: If the number j (given by <math>u_{14}</math>, <math>u_{13}</math>, <math>u_{12}</math>) is 0, stop the computer operation and provide suitable indication. If j is 1, 2, or 3 and the correspondingly numbered manual stop selecting switch is set to "stop", stop the computer operation and provide suitable indication. Whether or not a stop occurs, take (v) as the next instruction.</p> <p data-bbox="521 688 1409 720">(No Change in Content of Registers or Storage Positions.)</p>	
Instruction: PROGRAM STOP (PS--)	Operation Code: 57
<p data-bbox="302 850 1390 882">Function: Stop computer operation and provide suitable indication.</p> <p data-bbox="521 913 1409 945">(No Change in Content of Registers or Storage Positions.)</p>	

# CONTENT OF REGISTERS

Instruction: PRINT (PR-v)	Operation Code: 61
<p>Function: Replace (TWR) with the right-hand 6 bits of (v). Cause the electric typewriter to print the character to which this code corresponds.</p> <p>(No Change in Content of Registers or Storage Positions.)</p>	

Instruction: PUNCH (PUjv)	Operation Code: 63
<p>Function: Replace (HPR) with the right-hand 6 bits of (v). Cause the punch to respond to (HPR). If j = 0, omit seventh level hole; if j = 1, include seventh level hole.</p> <p>(No Change in Content of Registers or Storage Positions.)</p>	



# CONTENT OF REGISTERS

Instruction: MULTIPLY (MPuv)				Operation Code: 71	
Function: Form in A the 72-bit product of (u) and (v), leaving in Q the multiplier (u).					
Storage Class Selection		Content of Registers and Storage Positions after Operation is Executed.			
		$(MC)_f$ or $(MD)_f$		$(A)_f$	$(Q)_f$
u	v	u	v		
MC or MD	MC or MD	No Change	No Change	$(u) \cdot (v)$	(u)
	A	No Change	- - -	0	(u)
	Q	No Change	- - -	$(u)_i^2$	(u)
A	MC or MD	- - -	No Change	$(A_R)_i \cdot (v)$	$(A_R)_i$
	A	- - -	- - -	0	$(A_R)_i$
	Q	- - -	- - -	$(A_R)_i^2$	$(A_R)_i$
Q	MC or MD	- - -	No Change	$(Q) \cdot (v)$	No Change
	A	- - -	- - -	0	No Change
	Q	- - -	- - -	$(Q)^2$	No Change

# CONTENT OF REGISTERS

Instruction: MULTIPLY ADD (MAuv)				Operation Code: 72	
Function: Add to (A) the 72-bit product of (u) and (v), leaving in Q the multiplier (u).					
Storage Class Selection		Content of Registers and Storage Positions after Operation is Executed.			
		$(MC)_f$ or $(MD)_f$		$(A)_f$	$(Q)_f$
u	v	u	v		
MC or MD	MC or MD	No Change	No Change	$(A)_i + (u) \cdot (v)$	(u)
	A	No Change	- - -	$(A)_i + (u) \cdot (A_L)_i$	(u)
	A	No Change	- - -	$(A)_i + (u)^2$	(u)
A	MC or MD	- - -	No Change	$(A)_i + (A_R)_i \cdot (v)$	$(A_R)_i$
	A	- - -	- - -	$(A)_i + (A_R)_i \cdot (A_L)_i$	$(A_R)_i$
	Q	- - -	- - -	$(A)_i + (A_R)_i^2$	$(A_R)_i$
Q	MC or MD	- - -	No Change	$(A)_i + (Q) \cdot (v)$	No Change
	A	- - -	- - -	$(A)_i + (Q) \cdot (A_L)_i$	No Change
	Q	- - -	- - -	$(A)_i + (Q)^2$	No Change

# CONTENT OF REGISTERS

Instruction: DIVIDE (DVuv)				Operation Code: 73	
Function: Divide the 72-bit number in A by (u), putting the quotient in Q and leaving in A a non-negative remainder, R. Then replace (v) by (Q). The quotient and remainder are defined by: $(A)_i = (u) \cdot (Q) + R$ where $0 \leq R <  (u) $ .					
Storage Class Selection		Content of Registers and Storage Positions after Operation is Executed.			
		$(MC)_f$ or $(MD)_f$		$(A)_f$	$(Q)_f$
u	v	u	v		
MC or MD	MC or MD	No Change	$[(A)_i - R] / (u)$	R	$[(A)_i - R] / (u)$
	A	No Change	- - -	$D(Q)_f$	$[(A)_i - R] / (u)$
	Q	No Change	- - -	R	$[(A)_i - R] / (u)$
A	MC or MD	- - -	$[(A)_i - R] / (A_R)_i$	R	$[(A)_i - R] / (A_R)_i$
	A	- - -	- - -	$D(Q)_f$	$[(A)_i - R] / (A_R)_i$
	Q	- - -	- - -	R	$[(A)_i - R] / (A_R)_i$
Q	MC or MD	- - -	$[(A)_i - R] / (Q)_i$	R	$[(A)_i - R] / (Q)_i$
	A	- - -	- - -	$D(Q)_f$	$[(A)_i - R] / (Q)_i$
	Q	- - -	- - -	R	$[(A)_i - R] / (Q)_i$

# CONTENT OF REGISTERS

Instruction: SCALE FACTOR (SFuv)					Operation Code: 74	
<p>Function: Replace (A) with D(u) unless u is A. Then left circular shift (A) 36 places and continue shifting until <math>A_{35} \neq A_{34}</math>. Replace the right-hand 15 bits of (v) with the number of left shifts, k, necessary to return the final contents of A or <math>(A)_f</math> to the original position. The range of k, if u is A, is <math>0 \leq k \leq 71</math>; if u is MC, MD, or Q, k may be 0 or <math>37 \leq k \leq 71</math>. Effectively, the initial content of A, or <math>(A)_i</math>, which may be D(u) or D(Q) after the above replacement, is positioned in <math>A_R</math> (with the sign bit represented by <math>A_{35}</math> and the most significant bit by <math>A_{34}</math>) so that <math>(A)_f = (A)_i \cdot 2^s</math>. If <math>0 \leq k \leq 36</math>, the Scale Factor, <math>s = -k</math>; if <math>37 \leq k \leq 71</math>, <math>s = 72 - k</math>. Note that for <math>0 &lt; k \leq 36</math>, this positioning scales <math>(A)_i</math> "down"; for <math>37 &lt; k \leq 71</math>, <math>(A)_i</math> is scaled "up". If <math>k = 0</math>, <math>(A)_i</math> was properly positioned before any shifting operations; if <math>k = 37</math>, <math>(A)_i</math> is all ones or zero.</p>						
Storage Class Selection		Content of Registers and Storage Positions after Operation is Executed.				
		$(MC)_f$ or $(MD)_f$			$(A)_f$	$(Q)_f$
u	v	u	v <sub>15-35</sub>	v <sub>0-14</sub>		
MC or MD	MC or MD	No Change	No Change	k	$D(u) \cdot 2^{72-k}$	---
	A } Q }	SCC FAULT				
A	MC or MD	No Change	No Change	k	$(A)_i \cdot 2^{72-k}, 37 \leq k \leq 71$ $(A)_i \cdot 2^{-k}, 0 \leq k \leq 36$	---
	A } Q }	SCC FAULT				
Q	MC or MD	---	---	k	$(D(Q) \cdot 2^{72-k})$	No Change
	A } Q }	SCC FAULT				

# CONTENT OF REGISTERS

Instruction: REPEAT (RPjnw)	Operation Code: 75
<p>Function: Execute the following instruction n times modifying the u and v addresses of the instruction to be repeated according to the value of j. Afterward, continue the program by the execution of the instruction at F<sub>1</sub> whose v address is replaced by w.</p> <p>(No change in registers or storage positions except the v address of F<sub>1</sub> which is replaced by w.)</p>	

- Notes: 1. If the repeated instruction is a Threshold Jump (42uv) or an Equality Jump (43uv) and a jump occurs, the quantity  $j(n-r)$  from PAK is sent to the Q Register thus altering its contents.
2. If the n of the Repeat instruction is a zero, the Normal Repeat Termination is executed immediately and the next instruction is taken from F<sub>1</sub>.

# CONTENT OF REGISTERS

Instruction: EXTERNAL READ (ERjv)	Operation Code: 76
<p>Function: If j = 0, replace the right-hand 8 bits of (v) with (IOA);  if j = 1, replace (v) with (IOB). If the external unit utilizes step-by-step operation, advance one step.</p> <p>(No change in registers except as indicated by function above.)</p>	

Instruction: EXTERNAL WRITE (EWjv)	Operation Code: 77
<p>Function: If j = 0, replace (IOA) with the right-hand 8 bits of (v);  if j = 1, replace (IOB) with (v). Cause the previously selected unit to respond to the information in IOA or IOB.</p> <p>(No change in content of registers.)</p>	