

# Burroughs 205 Central Computer Handbook

BULLETIN 3021

## Burroughs 205

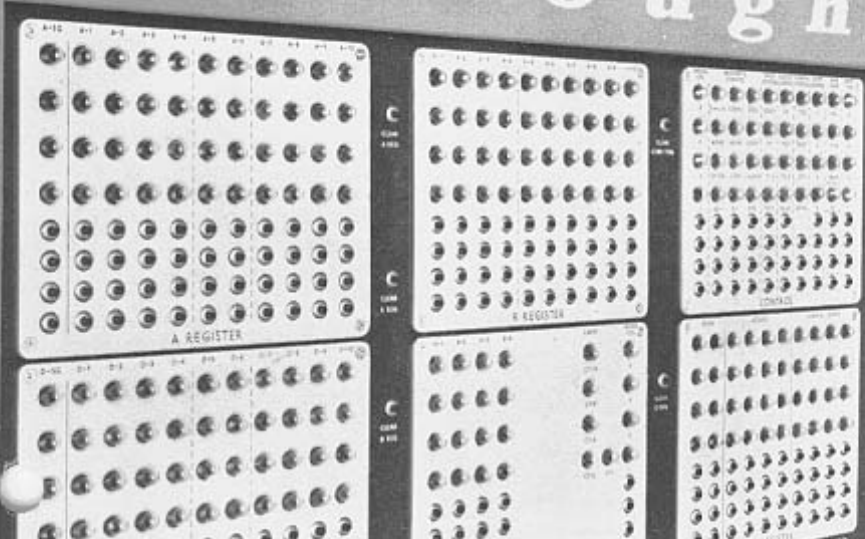
ELECTRONIC DATA-PROCESSING SYSTEMS

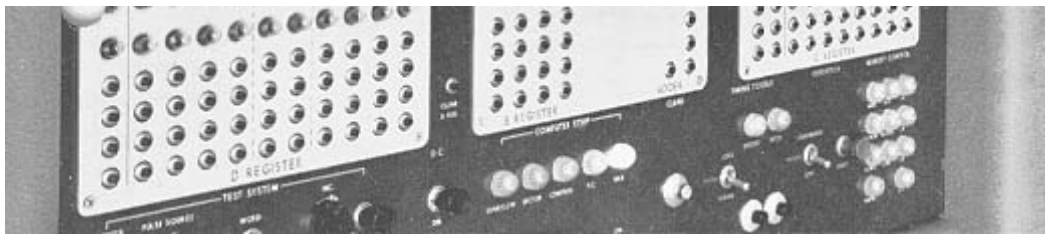
COMPUTER CENTER  
UNIVERSITY OF VIRGINIA  
McCORMICK ROAD  
CHARLOTTESVILLE, VIRGINIA

### HANDBOOK

### central computer

Burroughs





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This handbook supersedes and replaces previous editions of Bulletin 3010, Summary Instruction List, and Bulletin 3040A (Programming and Coding Manual). Symbols and nomenclature used to designate instructions conform to the revised standard

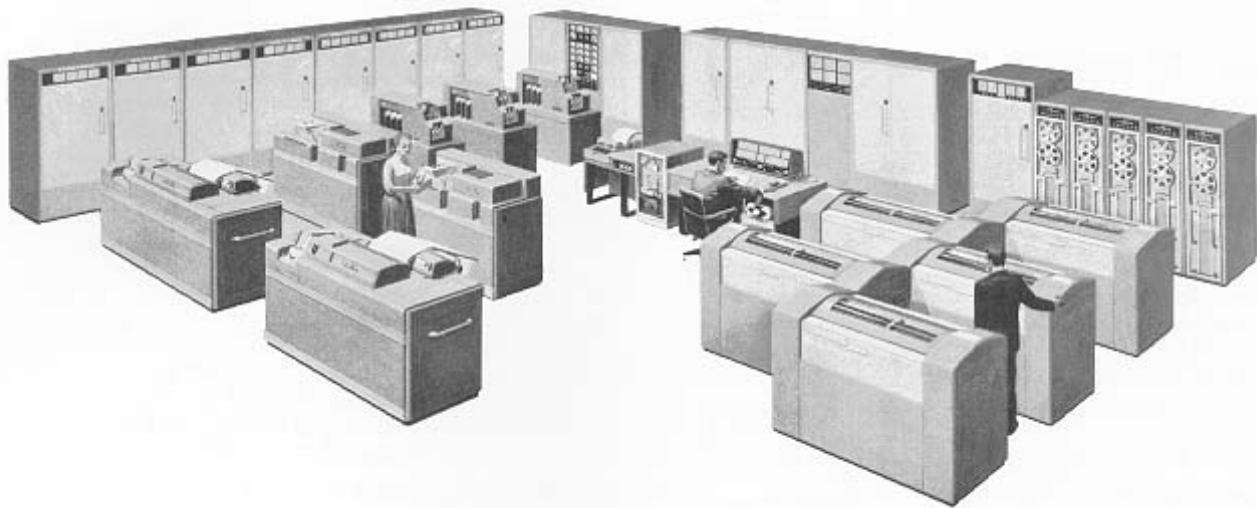
(Programming and Coding Manual). Symbols and nomenclature used to designate instructions conform to the revised standard practice adopted in March, 1956.

First printing March, 1956

Revised February, 1958

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## BURROUGHS 205 ELECTRONIC DATA-PROCESSING SYSTEMS

### GENERAL

Electronic data-processing systems have five components — input, storage (working and auxiliary), arithmetic, control, and output. This handbook describes the characteristics and explains the use of the Burroughs Electronic Data-Processing System Model 205. This unit, which consists of the Computer Cabinet, the Power Control, and Magnetic Amplifier Power Supply (Figure 1), contains the working storage, arithmetic, and control components of a complete system.

### BURROUGHS 205 COMPUTER

The computer is a general purpose, internally programmed, decimal, electronic computer with magnetic drum storage. It is the heart, or central controlling and processing unit, of an electronic data-processing system which accomplishes the functions of:

1. Accepting data directly from punched cards, punched tape, magnetic tape, keyboard — employing input units singly or in multiple.
2. Selecting from magnetic tape files the historical or reference records necessary to process data.
3. Processing data — comparing, computing, analyzing.

As a result of its ability to control data-processing systems of wide scope, and because of its economical and reliable operation, the Burroughs 205 has been applied effectively to a wide range of commercial, manufacturing, scientific and engineering problems.

In speed of computer operation, the Burroughs 205 is classed below the very large-scale electronic data processors — and considerably above card-programmed computers, other externally programmed computers, and the small, stored program computers.

In capacity and data-processing capability, the Burroughs 205 (as the central unit in a system) approaches large-scale systems in power and ability to produce an effective and economical flow of work.

### COMPONENTS OF THE BURROUGHS 205

The Computer Cabinet contains the arithmetic and control units (see Figure 1). The center section contains the magnetic drum working storage and the Control Panel. Switches, indicators, and displays required by the operator are mounted on this panel.

The Magnetic Electronic Power Supply is a compact, electronically controlled power system which provides all voltages necessary for the Burroughs 205 computing system. Many features are included, such as complete

- reference records necessary to process data.
3. Processing data—comparing, computing, analyzing, sorting, classifying as required—in obedience to a series of instructions which have previously been stored in the system (stored program).
  4. Bringing up to date the historical or reference records maintained on magnetic tape, and returning the up-dated records to magnetic tape.
  5. Transmitting required information directly into punched cards, punched tape, magnetic tape, printed documents, visual indications—employing output units singly or in multiple.

all voltages necessary for the Burroughs 205 computing system. Many features are included, such as complete metering circuits, metering display of all voltages, and dependable regulation under varying load conditions and input line variations.

The power system shown in Figure 1 is composed of three consoles: the Basic Power Control Unit (A cabinet); the Basic Power Supply Unit (B cabinet); and the Auxiliary Power Supply Unit (C cabinet). All Burroughs 205 Systems require the Basic Power Supply Unit and Power Control Unit. Only systems that include Cardatron require the additional Auxiliary Power Supply Unit.

## CHARACTERISTICS OF THE BURROUGHS 205

### HOW INFORMATION IS REPRESENTED

Information is represented in the Burroughs 205 as fixed length numbers, each of which contains ten decimal digits. Each ten digit number is preceded by an additional digit (Figure 2) which

- represents the algebraic sign of the number, or
- is sometimes used to control machine operation, or
- is an arbitrary zero having no special significance.

Each of these 11 digit units of information, called a **word**, may represent numerical data, alphabetic data, or a mixture (alphanumeric data), or an instruction which the Burroughs 205 is to obey. For example:

0 4259 64 4955 can represent + 4 259 644 955

0 4259 64 4955 can represent B R U I N

0 4259 64 4955 can represent "Clear the A Register. Add the contents of storage cell 4955."

By changing two digits in the sample word, an alphanumeric word can be represented:

0 4259 86 4955 represents Part Number B R 6 1 N

The interpretation of the word is controlled by the programmer as he arranges the instructions and data for input to the computer.

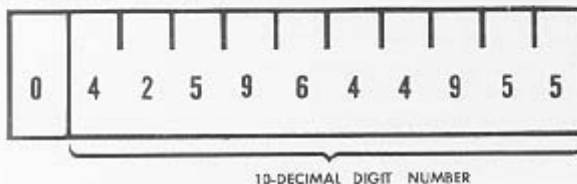


Figure 2

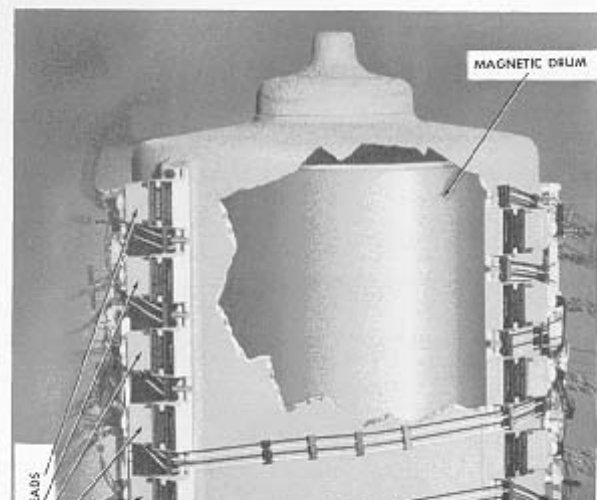
The 11 digit word is treated as a unit by the Burroughs 205. It is stored as a unit, and it is manipulated as a unit. However, if it is necessary to break up a word into smaller units of information, or to combine words into longer records, this can be done by placing the proper series of instructions in the Burroughs 205.

Once placed on the drum, information is retained (even if the power is turned off) until it is "erased" by writing new information on the drum over the old information.

Only the digits **zero** and **one** are represented on the surface of the magnetic drum—and this representation is made by magnetizing a small spot on the drum for each digit. All **zero** spots are magnetized in the same direction of polarity, and all **one** spots are magnetized alike in the opposite direction. Four such spots (called bits of information or binary digits) are used to represent one decimal digit. In this scheme of representation (binary-coded decimal), one bit of information is assigned the value 1, the second bit is assigned the value 2, the third bit is assigned the value 4, and the fourth bit is assigned the value 8. Decimal digits are represented according to the following table:

	0	1	2	3	4	5	6	7	8	9
8 Bit	0	0	0	0	0	0	0	0	1	1
4 Bit	0	0	0	0	1	1	1	1	0	0
2 Bit	0	0	1	1	0	0	1	1	0	0
1 Bit	0	1	0	1	0	1	0	1	0	1

Write heads and read heads are mounted on the magnetic drum casing (Figure 3). As the drum cylinder revolves inside the casing, the surface of the drum passes these heads. The function of each write head is to place



## HOW INFORMATION IS STORED

Over 4000 words of information are stored on the surface of a large-capacity magnetic drum which revolves at 3570 revolutions per minute. This unusual storage capacity makes possible

- adequate reference to data,
- adequate facility for classification of data,
- convenient use of long programs,
- convenient insertion of temporary programs for "spot" analysis,
- improved internal sorting techniques, and
- a reduction, in many cases, in the number of times the same data must be fed through the central data processor to secure the desired results.

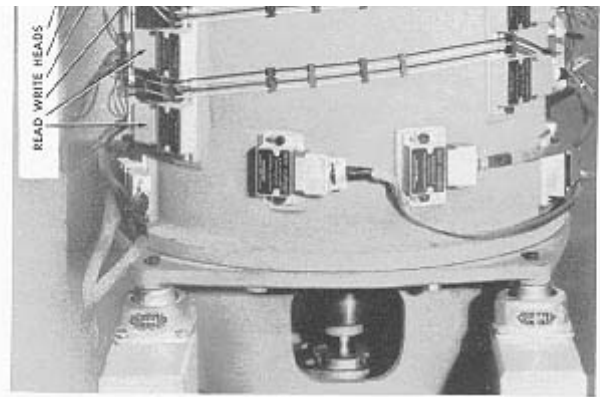


Figure 3 Magnetic Drum Assembly

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information on the surface of the drum by magnetizing four spots at a time according to the code tabulated above. The function of each read head is to interpret the pattern of magnetic spots on the surface of the drum, four bits of information at a time, thus making the information available for use.

## LOCATION OF INFORMATION ON THE MAGNETIC DRUM

A space on the drum large enough to write the contents of exactly one word is called a **storage cell**. Storage cells are arranged in bands which extend around the circumference of the magnetic drum. Each band consists of four tracks of magnetized spots (Figure 4), making possible the use of the binary-coded decimal scheme of representing digits. Four **zeros**, one in each of the tracks, separate each word from its adjoining words. Associated with each band is a read head and a write head, or a combination read-write head.

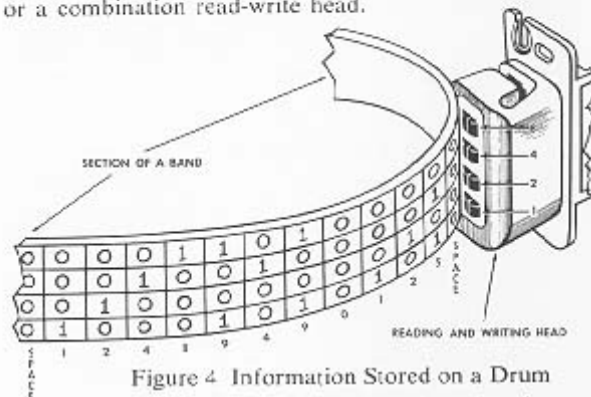


Figure 4 Information Stored on a Drum

Each storage cell on the magnetic drum has its own **address**, a four digit number which identifies the cell and specifies its location. The top 20 bands on the magnetic drum (Figure 5) each contain 200 words, a total of 4000 storage cells being located in the portion of the magnetic drum called **main storage**. The addresses of these cells are the numbers 0000 through 3999.

The bottom four bands on the drum are reserved for high-speed storage. Only 20 different words are stored in each of these quick-access bands, but each word is repeated ten times at equal intervals around the drum. This provides the basis for faster access to each word in the band—as described below.

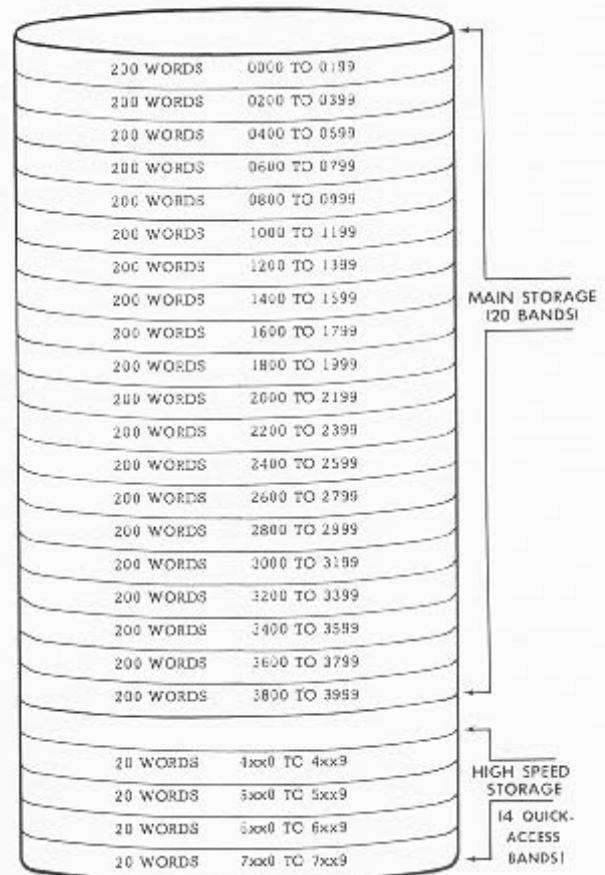


Figure 5 Location of Information on Magnetic Drum

seconds (17 milliseconds). The average access time for the word is 8.5 milliseconds, the time for a half-revolution of the drum.

Each quick access band has a **separate** read head and, 20 words distant from this head along the drum circumference, a **separate** write head (Figure 7). Since a complete band around the magnetic drum contains 200 words, these two heads are one-tenth of the drum cir-

repeated ten times at equal intervals. This provides the basis for faster access to each word in the band—as described below.

The bands can be addressed from 4000 through 4999, 5000 through 5999, 6000 through 6999, and 7000 through 7999. Because each word is repeated ten times, the word in 4000 will be repeated in 4020, 4040, 4060, 4080; however, the word can be addressed without regard to the second address digit. Thus the word in 4000 could be addressed as 4100, 4520, 4760, 4980, etc.; cell 5569 will contain the same word as cell 5009; cell 6738 will contain the same word as cell 6018, etc.

### OPERATION OF QUICK-ACCESS BANDS

Each main storage band has associated with it **one combination** read-write head (Figure 6). A word stored in a main storage cell passes the read-write head only once in every revolution of the magnetic drum. A word stored in a main storage cell is available for use, then, once in every revolution of the drum. The access time (or waiting time) for this word can vary from zero to 0.017

a complete band around the magnetic drum contains 200 words, these two heads are one-tenth of the drum circumference apart.

As each word passes under the read head, it is **always** immediately rewritten twenty words back along the drum circumference. If a block of 20 words is placed in a quick access band this continual process of reading and writing will duplicate the 20 words in **ten locations** around the drum—in the first revolution of the magnetic drum following the transfer of information into the band.

A word stored in one of the cells of a quick access band is available for use once in every one-tenth of a drum revolution, or **ten times in every revolution**. In effect, the quick access bands supply data and instructions at the same rate as if the magnetic drum were revolving at 35,700 revolutions per minute. The access time for a word in a band can vary from zero to 1.7 milliseconds. The average access time for a word stored in a band is 0.85 milliseconds.

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In most applications, Burroughs 205 instructions are transferred from main storage into the quick access bands before the execution of the instructions. Similarly, data and intermediate results are normally stored in the quick access bands, or transferred from main storage into the quick access bands.

To accomplish the necessary manipulation of information, block transfer instructions are used. These instructions move 20 words at a time from main storage to band, or from band to main storage, at the rate of 1.7 milliseconds per block of 20 words. This is the amount of time required for 20 words to pass by a read head. The actual transfer of each digit is almost instantaneous.

Words transferred from main storage to a band remain (in unaltered form) in main storage, facilitating the process of making memo entries in records. Words transferred from a band to main storage remain (in unaltered form) in the band.

Burroughs 205 programs are written to maintain a continuous flow of data and instructions through the bands. Thus, the Burroughs 205 maintains the high rate of processing associated with optimal (or minimal access) programming, but retains the reliability inherent in a conservative speed of drum revolution.

### ELECTRONIC REGISTERS

On the magnetic drum, each decimal digit is represented by a combination of four magnetized spots, each spot being an indicator of either **zero** or **one**. This method of representing information has proved to be extremely reliable.

An electronic circuit, called a **flip-flop**, can also represent **zero** or **one** by being in one of two possible states—either “low” or “high.” Several registers, or storage cells with zero access time, use the **flip-flop** circuit to store information. In these registers, each decimal digit is represented by four flip-flops. Just as in the case of the magnetized spots on the magnetic drum, relative values are assigned to each flip-flop. The first flip-flop is assigned the value 1, the second flip-flop is assigned the value 2, the third flip-flop is assigned the value 4, and the fourth flip-flop is assigned the value 8. Decimal digits are

### ARITHMETIC REGISTERS

Three electronic registers are used to contain numbers involved in computation and data processing (Figure 8).

**A Register** holds an 11 digit word. This register is an accumulator in which the results of all arithmetic operations appear.

**R Register** holds ten decimal digits. This register is primarily an extension of the A Register. However, multiplication and division are the only arithmetic operations which affect the R Register.

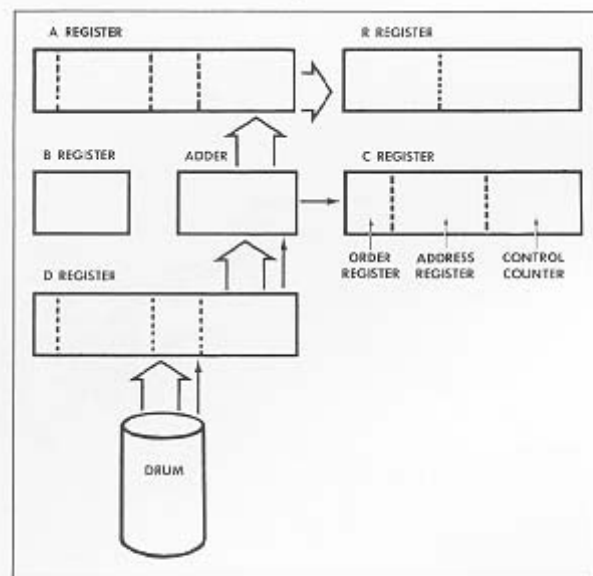


Figure 8 Arithmetic Registers

**D Register** holds an 11 digit word which cannot be manipulated by the programmer. Words entering the A, R and C registers from an input medium, or from main storage, first pass through this register.

In an arithmetic operation one of the numbers involved is always in the A Register, or in the combined

value 2, the third flip-flop is assigned the value 4, and the fourth flip-flop is assigned the value 8. Decimal digits are represented in electronic registers according to the table of combinations used to represent decimal digits on the drum. (Refer to How Information is Stored.)

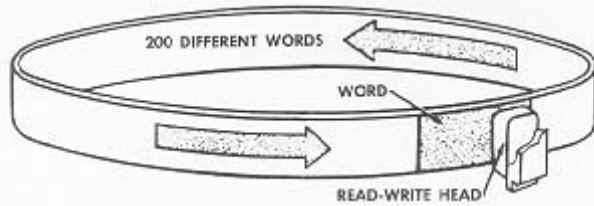


Figure 6 Access to Word Stored in Main Storage Band

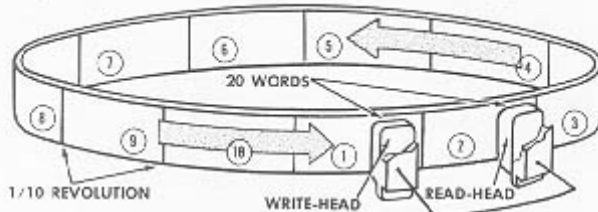


Figure 7 Access to Word Stored in Quick Access Band

In an arithmetic operation one of the numbers involved is always in the A Register, or in the combined A Register and R Register. The second number involved is always transferred from the drum into the D Register.

### INSTRUCTION FORMAT

A Burroughs 205 instruction is made up of three parts (Figure 9):

- (a) the four digit address – which designates the location of the storage cell referred to during execution of the instruction;
- (b) The two digit order – which designates the specific operation to be performed;
- (c) the four control digits – which designate variations in the execution of the instruction

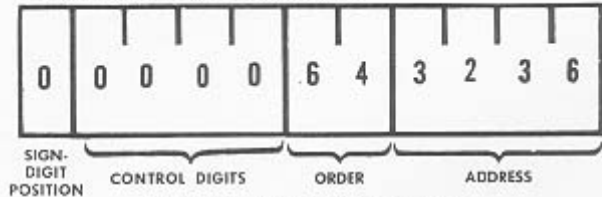


Figure 9 Instruction Format

## C REGISTER

**C Register** receives each instruction from the magnetic drum through the D Register (Figure 10). The function of this register is to start the operation of the control component of the computer.

The C Register is composed of three sub-registers (reading from left to right):

**Order Register** holds the two digits which designate the specific operation to be performed.

**Address Register** holds the four digits which designate the location of the storage cell referred to during execution of the instruction. The contents of the Order Register and the Address Register, together, are the same as the six right hand digits of the instruction word as it appears in the D Register and on the magnetic drum.

**Control Counter** holds the four digits which specify the address of the next instruction which will be executed – after the completion of the operation specified in the Order Register and the Address Register.

### OPERATION SEQUENCE

In normal, continuous operation, instructions are executed in the order in which they are stored on the magnetic drum. Thus, if instructions are stored in storage cells 1000, 1001, and 1002, the instruction stored in cell 1001 will be executed after the instruction stored in cell 1000 and the instruction stored in cell 1002 will be executed after the instruction stored in cell 1001.

The Control Counter counts up 1 after each instruction comes into the C Register so that the next instruction will be read from the next cell. In the preceding example, when the instruction stored in cell 1000 is being executed,

the Control Counter will read 1001. When the instruction stored in cell 1001 is being executed, the Control Counter will read 1002 (Figure 10).

To change this normal method of sequential operation, change of control instructions are used. These instructions may be used to alter the sequence of instruction execution arbitrarily – in which case they are **unconditional changes of control**. A similar series of instructions may be used to alter the sequence of instruction execution only in response to the presence of a machine condition (see **Overflow**, below). These **conditional changes of control** are used for decision-making or branching.

Instead of allowing the Control Counter to count up 1, the change of control instructions insert their address digits into the Control Counter, and thus specify the next instruction to be executed.

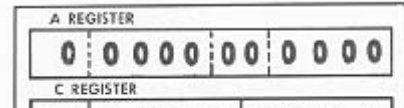
### TIMING CYCLE

The timing cycle of the Burroughs 205 has two distinct phases:

In the **fetch phase** of the timing cycle (Figure 11), the instruction word located in the storage cell specified in the Control Counter is brought from the magnetic drum, through the D Register, through the Adder, to the C Register.

In the **execute phase** of the timing cycle (Figure 12), the data word specified in the instruction just fetched is brought from the magnetic drum, through the D Register, through the Adder (where an arithmetic operation takes place) to the A Register.

The fetch phase and the execute phase alternate as the timing cycle repeats.



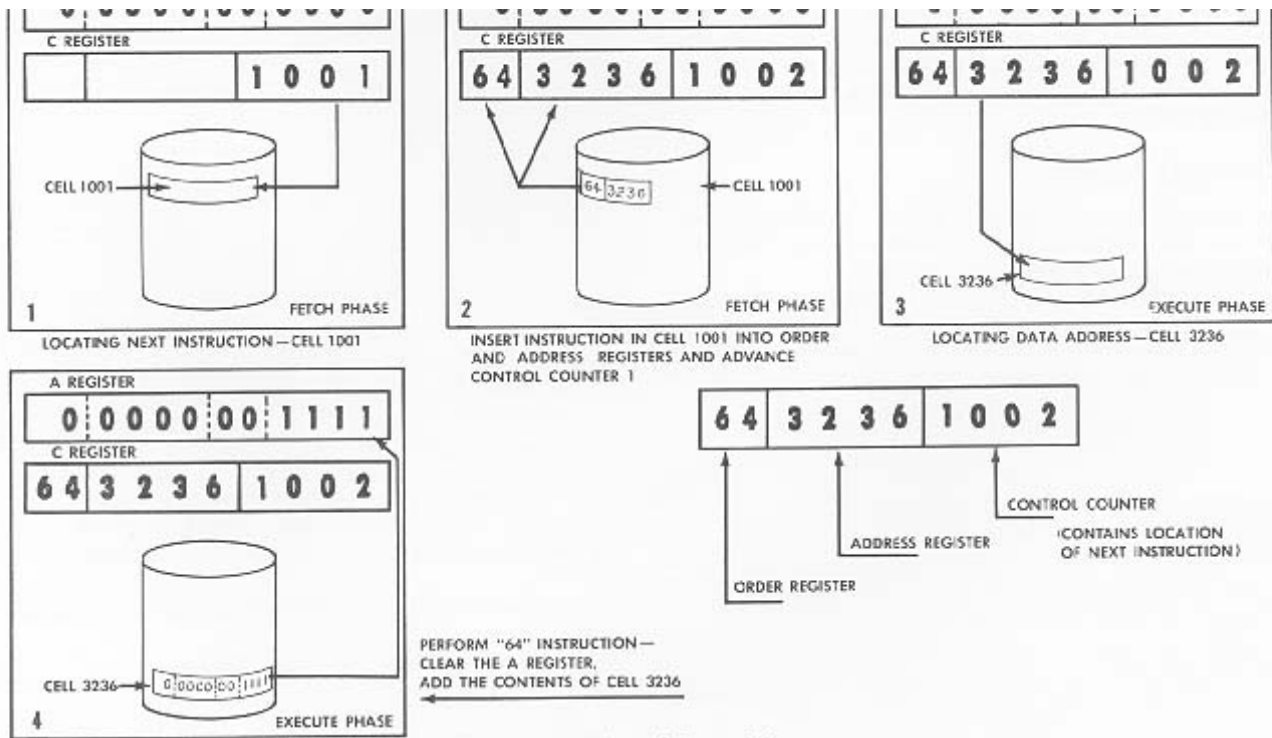


Figure 10 Action of Control Counter

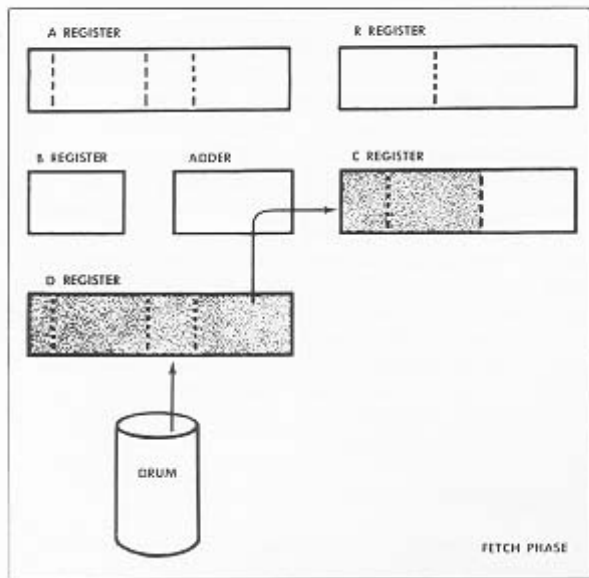


Figure 11 Timing Cycle

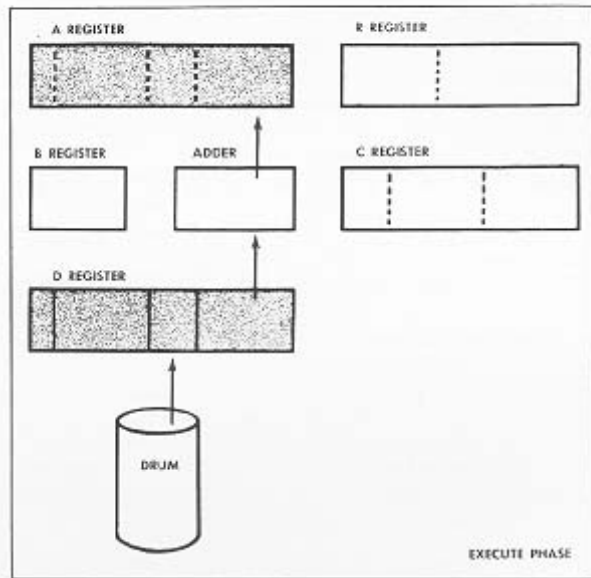
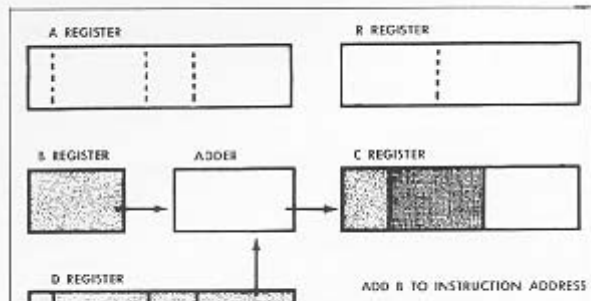


Figure 12 Timing Cycle

**B REGISTER**

The **B Register** holds any four decimal digits from 0000 to 9999. These digits can be added to the address digits of an **instruction word** as the instruction goes through the Adder to the C Register (Figure 13).

The addition of the contents of the B Register to an instruction (address modification) is signaled by the first control digit of the instruction word, when the word reaches the D Register. If the digit is 1, the contents of the B Register are added. If the control digit of the



reaches the D Register. If the digit is 1, the contents of the B Register are added. If the control digit of the instruction word is 0, the contents of the B Register are not added (see Figure 11).

The contents of the B Register can be increased by **one**, or decreased by **one**, during the execution of a series of instructions. When the series of instructions is repeated many times, the B Register can serve, in this case, as a tallying device.

## DECIMAL POINT

Inside the computer, a decimal point is considered to be fixed at the left of each ten digit word stored on the magnetic drum or in the electronic registers.

The eleventh digit, at the left of the decimal point, represents the algebraic sign of numerical data (**zero** for **plus** and **one** for **minus**), or (in the case of an instruction word) is sometimes used to control machine operation, or (in the case of alphabetic or alphanumeric data) is an arbitrary zero having no special significance.

Outside the computer, the decimal point may be located in its proper position (by programming) regardless of its internal position. For example:

Internally		Externally
0 1621 00 0000	} may represent	16.21
0 0001 62 1000		
0 0000 00 1621		

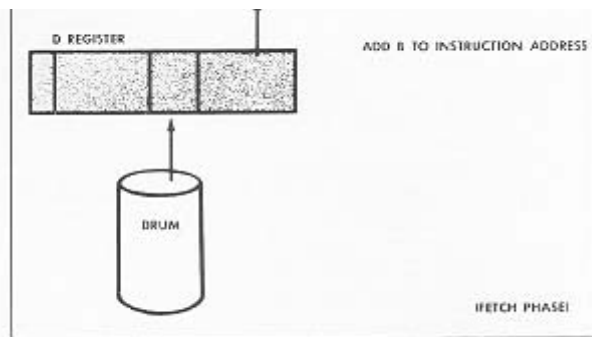


Figure 13 B Register Modification

## OVERFLOW

Whenever the execution of an instruction produces a result which is too large to be inserted in the A Register, an **overflow condition** is set up in the computer. This condition will cause the computer to stop, unless a conditional change of control instruction follows the instruction that caused the overflow condition (previously discussed in the section, **Operation Sequence**). The presence of the overflow condition is determined as follows:

Indication to computer—Overflow flip-flop is in a “high” state.

Indication to operator—Overflow light is ON.

### EXAMPLE 1

Actual Arithmetic	Computer Arithmetic
0.9000 00 0000	0 9000 00 0000
+0.8000 00 0000	0 8000 00 0000
1.7000 00 0000*	0 7000 00 0000**
*Carry produces number to the left of the decimal point.	**Overflow indicator ON. Zero to the left of decimal point position represents plus sign. The resulting ‘carry one’ is lost.

### EXAMPLE 2

Actual Arithmetic	Computer Arithmetic
$0.3000\ 00\ 0000 \overline{) 3.0000\ 00\ 0000^{\circ}}$	$0\ 3000\ 00\ 0000 \overline{) 0\ 9000\ 00\ 0000^{\circ}}$
*Division of larger number by a smaller number produces a whole number or overflow to the left of the machine decimal point.	**Overflow indicates ON. Zero to the left of

The overflow condition may follow the arithmetic manipulation of the contents of the A Register. Overflow **always** follows the test for and detection of a difference between the algebraic sign of the A Register and the sign of a number brought from a storage cell for comparison.

When the possible appearance of an overflow is anticipated, a conditional change of control instruction is inserted in the program to allow the program to branch (take one of two possible alternate paths). When an unanticipated overflow occurs (a programming error) the computer stops.

## CHECKING FACILITIES

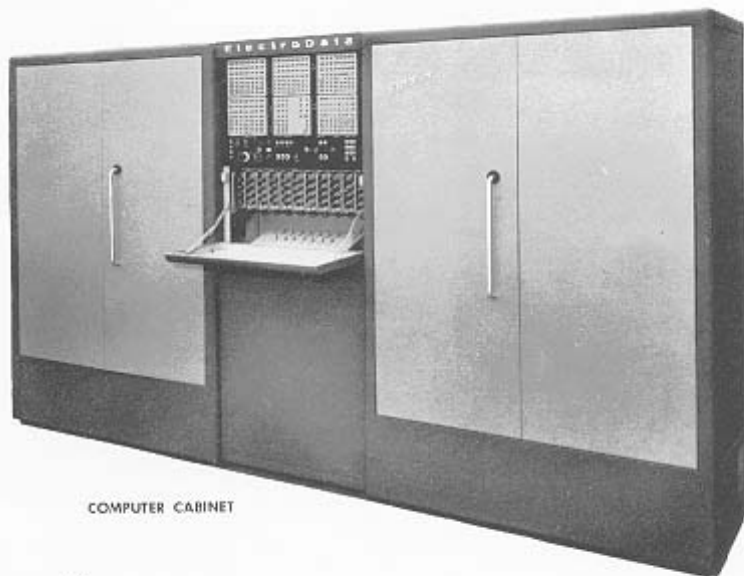
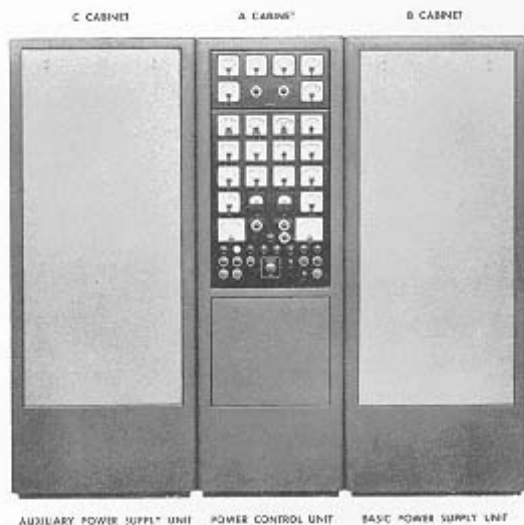
When the computer automatically stops upon the appearance of an unanticipated overflow, an alarm light is turned on and computation is stopped by a forbidden combination (binary-coded decimal digits 10 through 15) in the A, B, D, or R Registers, the Address Register, the Control Counter, or the Shift Counter. Inspection of the register contents as indicated on the Control Panel indicates the failure.

An alarm will stop machine operation if the storage cell counter does not contain 0 at the start of each drum revolution. This check prevents information from being recorded on or read from incorrect locations on the drum.

An audible alarm indicates excessive rise in exhaust air temperature in the computer cabinet and after a preset interval up to 15 minutes, dc voltages will be shut off if the temperature stays at or above a predetermined

°° Overflow indicates ON. Zero to the left of decimal point position represents plus sign.

preset interval up to 15 minutes, dc voltages will be shut off if the temperature stays at or above a predetermined level.



## COMPUTER INSTRUCTIONS

This section defines the Burroughs 205 instructions available to the programmer and illustrates their use.

### ARITHMETIC

#### Instructions for Addition and Subtraction.

Addition and subtraction instructions affect the A Register, but not the R Register.

The series of instructions below illustrates the use of the add and subtract instructions and the effect that each instruction has on the A Register and the R Register.

Assume that:

1. Storage cell 1000 contains the number 0 2222 22 2222.
2. Storage cell 1001 contains the number 1 3333 33 3333.
3. The A Register contains the number 1 9874 53 1234.
4. The R Register contains the number 0000 560000.
5. Insert a 7 on Keyboard for Digit Add.

**CAD**  
000p 64 xxxx  
Clear the A Register. Add the contents of xxxx.

**AD**  
000p 74 xxxx  
Add the contents of xxxx to the contents of the A Register.

**ADA**  
000p 76 xxxx  
Add the absolute value of the contents of xxxx to the contents of the A Register.

**CLEAR, ADD**

**ADD**

**ADD ABSOLUTE**

Program	A Register	R Register
	1 9874 53 1234	

**000p 76 xxxx**  
Add the absolute value of the contents of xxxx to the contents of the A Register.

**CADA** CLEAR, ADD ABSOLUTE  
**000p 66 xxxx**  
Clear the A Register. Add the absolute value of the contents of xxxx.

**CSU** CLEAR, SUBTRACT  
**000p 65 xxxx**  
Clear the A Register. Subtract the contents of xxxx.

**SU** SUBTRACT  
**000p 75 xxxx**  
Subtract the contents of xxxx from the contents of the A Register.

**CSUA** CLEAR, SUBTRACT ABSOLUTE  
**000p 67 xxxx**  
Clear the A Register. Subtract the absolute value of the contents of xxxx.

**SUA** SUBTRACT ABSOLUTE  
**000p 77 xxxx**  
Subtract the absolute value of the contents of xxxx from the contents of the A Register.

**DAD** DIGIT ADD  
**0000 10 0000**  
Stop machine operation. Add the next digit read (from manual keyboard or paper tape reader) to the least significant position of the A Register.

Program	A Register	R Register
	1 9874 53 1234	
CAD 1000	0 2222 22 2222	0000 560000
AD 1001	1 1111 11 1111	0000 560000
ADA 1001*	0 2222 22 2222	0000 560000
CADA 1001*	0 3333 33 3333	0000 560000
CSU 1000	1 2222 22 2222	0000 560000
SU 1001	0 1111 11 1111	0000 560000
CSUA 1001*	1 3333 33 3333	0000 560000
SUA 1001*	1 6666 66 6666	0000 560000
DAD 0000	1 6666 66 6659	0000 560000

\*In addition and subtraction of absolute numbers, the number is treated as a positive number, regardless of its sign.

The condition of overflow in AD, ADA SU, SUA is possible and will appear as follows:

Program	A Register	R Register
	1 9874 53 1234	0000 560000
*SU 1000	1 2096 75 3456	0000 560000
SUA 1001	1 5430 08 6789	0000 560000
CADA 1001	0 3333 33 3333	0000 560000
ADA 1001	0 6666 66 6666	0000 560000
ADA 1001	0 9999 99 9999	0000 560000
*ADA 1001	0 3333 33 3332	0000 560000

\*Overflow indicator ON.

**Addition and Subtraction instructions can be used in:** posting, accumulating receipts, debiting and crediting accounts and, in general, updating records.

**PROBLEM:** A store has four sections. Following each day's business the owner wants to know net receipts. Each section reports total receipts and amount of sales commissions.

**TO FIND:** Net Receipts

**ASSUME:** Information from sections located in storage cells:

1000	0 0000 01 9432	(Section 1 - Sales - 194.32)
1001	0 0000 00 3886	(Section 1 - Commissions - 38.86)
1002	0 0000 01 5203	(Section 2 - Sales - 152.03)
1003	0 0000 00 3040	(Section 2 - Commissions - 30.40)
1004	0 0000 00 9367	(Section 3 - Sales - 93.67)
1005	0 0000 00 1873	(Section 3 - Commissions - 18.73)
1006	0 0000 01 0152	(Section 4 - Sales - 101.52)
1007	0 0000 00 2030	(Section 4 - Commissions - 20.30)

**SOLUTION:**

## SOLUTION:

Location		S	Control Digits	Operation		Operand Address	Remarks
Main	Loop			No	Alpha		
000	0				CAD	1000	A = 0,0000 01 94.32
000	1				SU	1001	A = 0,0000 01 55.46
000	2				AD	1002	A = 0,0000 03 07.49
000	3				SU	1003	A = 0,0000 02 77.09
000	4				AD	1004	A = 0,0000 03 70.76
000	5				SU	1005	A = 0,0000 03 52.03
000	6				AD	1006	A = 0,0000 04 53.55
000	7				SU	1007	A = 0,0000 04 33.25

ANSWER: Located in the A Register represents \$433.25

Λ = machine decimal point

• = programmer's decimal point

**PROBLEM:** A bank keeps current balances for checking accounts in a file in main storage. The account numbers vary from 00000 to 99999, but only 1500 accounts exist. As before, the problem is to post transactions in the current balance file.

In this case, there is no correspondence between account number and storage location. For example, the current balance for account number 14708 may be in storage location 1695, while 1696 contains the current balance for account number 35614. The file is maintained in account number sequence however. A dictionary must be provided which will relate the account number to the location where the current balance is stored.

The solution to this problem, as given below, is fairly complex. However, it shows the Burroughs 205 performing a practical operation at high efficiency, and demonstrates the power of this table look-up technique.

**SOLUTION:** Table #2 is composed of 1500 current bal-

to Table #1. The first two digits of the account number will correspond to a storage cell in Table #3. The instruction address of the BT4 instruction in that cell will refer to Table #1. This table is stored in 0000-0099, and makes possible a very rapid look-up of the account number, in the following way.

1. An input account number is in 5000, and the amount to be posted in 5001.
2. The first two digits of the account number call for the appropriate BT4 order from the Table #3 in 0000-0099.
3. A BT4 instruction is executed, bringing a block of 20 account numbers from Table #1 into hand 4.
4. The 20 account numbers are searched by sequential comparison, and the desired account number is found. This is the only actual search necessary.
5. The address accompanying the matched account num-

states the power of this table look up technique.

SOLUTION: Table #2 is composed of 1500 current balances stored in locations 1600-3099, and Table #1 is composed of 1500 account numbers stored in locations 0100-1599. With each account number is stored the address of its balance (Table #2) so that the entry has the following form.

A  
Table #1 Entry } = 0 dddd xxxxx  
                  } dddd = address of current balance in Table #2.  
                  } xxxxx = account number

The table of account numbers, Table #1, is arranged in ascending sequence. A third table, Table #3, is constructed, which consists of 100 BT4 instructions referring

This is the only actual search necessary.

5. The address accompanying the matched account number is used to refer to the proper cell in the Table #2.
6. The posting is performed, and the operation is complete.

Table #3	Table #1	Table #2
Cells 0000-0099	Cells 0100-1599	Cells 1600-3099

Table 1 BT4 addresses.      Account numbers and Table 2 addresses.      Current balances.

Location		Control Digits	Operation No	Alpha	Operand Address	Remarks
Main	Loop					
0	698 0		CAD	5000		GIVEN ACCOUNT NUMBER A=0.0000 011111
1	698 1		SR	0003		A=0.0000 00 0011
2	698 2		AD	7001		A=0.0000 64 0011 (CAD 0011)
3	698 3		STC	6984		
4	698 4		[CAD	0011]		COMMAND MADE UP BY PRECEDING THREE COMMANDS
5	698 5		STC	6986		(6986)=0.0000 BT4 (0100-1599)
6	698 6		[BT4	---		
7	698 7		SB	7000		SET (B) to 19
8	698 8		CAD	4000		A=0 dddd 1111
9	698 9		CR	0000		--0--
0	699 0		SL	0005		A=0.1111 0000 00000000
1	699 1		CIRA	0005		A=0.0000 1111 TABLE LOOK UP
2	699 2		SU	5000		
3	699 3		CNZ	6999		
4	699 4		SL	0010		A=0.0000 00 dddd
5	699 5		AD	7001		A=0.0000 64 dddd
6	699 6		ST	7004		
7	699 7		CU	7002		
8	699 8	0 0000		62	0000	CONSTANT
9	699 9		DB	6988		TALLY
0	700 0		STOP	0019		VALUE NOT IN TABLE ACCOUNT NUMBER INCORRECT
1	700 1	0 0000		64	0000	CONSTANT 64 = CAD
2	700 2		SU	6998		A=0.0000 02----;02-STC
3	700 3		STC	7006		
4	700 4		[CAD	---		MADE UP BY COMMAND IN 6996
5	700 5		AD	5001		POST AMOUNT
6	700 6		[STC	---		MADE UP BY COMMAND IN 7003
7	700 7		STOP	0000		
8						