Microcomputer Dictionary & Guide

MICROCOMPUTER DICTIONARY AND GUIDE

by
Charles J. Sippl
and
David A. Kidd

including:

A Programmable Calculator Glossary —

Appendices:

- Mathematics Definitions
- Statistics Definitions
- Computer Number and Binary Switching Systems
- Electronics and Computer Abbreviations
- APL, Basic and Fortran Language Summaries
- Symbols, Units and Constants of Electronics

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MICROCOMPUTER DICTIONARY AND GUIDE

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ACKNOWLEDGEMENTS: Basic reference source for many of the terms and definitions and for four of the appendices in this dictionary is "Computer Dictionary and Handbook" published by Howard W. Sams & Co., Inc., 4300 West 62nd Street, Indianapolis, Indiana 46268. It is available through book stores, electronic parts distributors, or directly from the publisher. Approximately six hundred of the more fundamental electronics definitions are excerpted from "Chambers Dictionary of Electronics and Nucleonics" with the permission of W & R Chambers, Ltd., Edinburgh, Scotland.

Many of the communications-oriented definitions can also be found, with significant elaboration, in the large volume, "Data Communications Dictionary," published in 1976 by Van Nostrand-Reinhold Company, New York.

How To Use This Book

The dictionary section of this book follows the standards accepted by most, but not all, modern lexicographers. All acronyms and terms of more than one word are treated as one word. For example, "PDM (pulse-duration modulation) appears between "PC Testing" and "peak." Abbreviations are also treated alphabetically, and the letters "I/O" follow "inverter" rather than appearing at the beginning of the I's.

For ease in quickly locating a specific term, the first and last entries on each page appear as reference words at the top of each page.

Extensive cross-referencing has been used as an aid in locating terms which you might look for in more than one place. For example, "ECL" may also be located as "emitter coupled logic." If you are not sure whether you want "memory" or "storage," check both; I^2L is filed as it would read, "I squared L," thus under "Isq." Again, think of each *group* of letters or words as a single word, including "ings" and "eds," then follow strict alphabetization to facilitate location efforts.

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Preface

The literature of electronics, computers, communications, and industrial automation is filled with promises and proofs of a microcomputer control revolution. For the more enthused proponents and product developers, it has turned into a craze. ". . .More important than the invention of the transistor. . ." ". . .greater impact than the electric motor. . ." ". . .a computer in every home. . ." ". . .the $10 computer is here. . ." "When the history of digital electronics is written, 1976 will be remembered as the year of the microcomputer explosion. . ." ". . .for the third time in two decades, the computer industry is experiencing the beginning of another revolution. . ." Most of us have read or heard these claims and practically no one disagrees.

All major component companies and thousands of manufacturers and fabricators around the world are developing excellent microsystem control products, and practically every one of them is relying on the rapid, pragmatic education of an increasing multitude of potential customers who can beneficially and profitably use these most versatile and cost-effective products. Individual, professional and academic education programs need direction, expansion---and help.

Quite frenzied efforts are in progress to educate potential users in many markets. They are being developed in standard ways: advertisements, product manuals, articles in periodicals, conferences, college courses, etc. Perhaps the most intense and effective are: concentrated, in-depth traveling and in-house teaching classes and seminars; the efforts of microcomputer clubs and user groups and their publications, and a coming onslaught of books. But, again a major problem is one of verbal communication--the need for newcomers and oldtimers alike to learn the nomenclature--the new language--the developing terms and concepts with all the nuances, cross-meanings and varied interpretations.

The need for a Microcomputer Dictionary that offers clear explanations of products, procedures, systems, techniques and components appears quite apparent, but the dictionary and its definitions cannot be standard, pure or "idealized". The work must reflect the current literature--the use of the words as they are spoken and written by today's inventors, teachers, lecturers, writers and leaders. Few "explanations" can be curt or brief because they must be "real"--down to earth, simplified, but also tutorial and expository. Microelectronics dictionaries cannot wait for the perfection of microscript rhetoric that appeals to purist lexicographers. The definitions and concept explanations must come from the industry, from the developers and users of these systems. The dictionary cannot be a reshuffle of words; it must be developed to establish the many facits of microcomputer operations, applications, newest developments—"the way it is"—nothing more; nothing less.

This first edition "Microcomputer Dictionary" attempts to fill this need with over 5000 entries of terms, definitions and product, procedure and applications explanations. The current literature was the source of virtually all the up-to-date information on microcomputer technology and utilization to produce the desired accuracy, thoroughness and avoidance of trivia. The authors were strongly determined that the great majority of the definitions are derived from or based on product, system and design manuals, scholarly reports, conference proceedings, monographs, etc. The emphasis is on how the terms are specifically used in the industry by product manufacturers, system designers, and application developers.

Rapid changes in the microprocessor/microcomputer field continuously spawn several hundreds of new concept, product, and technique definitions. Besides all the major electronic component and computer manufacturers, literally thousands of new companies around the world are rapidly entering the microsystems fields of enterprise. Practically all engineers, computer and communications professionals, production managers, scientists, teachers and wide ranges of students and other readers now have deep involvement in a massive microelectronics upheaval. Basic, updated and additional definitions and concept explanations must be offered periodically to help these people with the lexicon of the literature and to lead them through a new labryinth of 'computerese.' A "supplemental pages" program is being planned to offer readers continued assistance for staying abreast of latest developments, changes, new product explanations and of microsystems' applications progress.

Several pages of randomly selected definitions in this book can serve as examples of product, process and procedure complexity — from 'avalanche breakdown' through 'IC photomasking,' to 'zwitterion.' Many of these explanations are relatively long, and most "browsing" readers of this book welcome the depth of analysis including examples. Most terms are not so exotic but many still require deeper treatment than mere 'dictionary phrasing.' The proper book is, in essence, an encyclopedia — and Matrix Publishers, Inc.,' has a "Concise Microelectronics Encyclopedia" in preparation.

For most people, the new micro technology is exciting, esoteric and complex. But utilization and product applications are pragmatic and consistently profit-generating. This brings wide ranges of businessmen, industrialists, and the entire computer/communications world quickly into the microelectronics revolution. The careful development and thoroughness of this work is designed to be helpful to the totally new educational development for some and urgent updating for others.

The microprocessor is the basic building block for hundreds of new microcomputer control systems. The digital 'processor on a chip' performs the same arithmetic, logic, information and device control that standard and minicomputers achieve. . .but at from one-tenth to one-hundredth of the cost, size and power requirements. 'Chip sets', a term that has recently evolved into popular usage, develop the microprocessor power, expand computer memory using ROM and RAM, and with appropriate interface and Input-Output devices complete a total computer system that can be held in one hand. These micropower marvels are also known as microcontrollers and are being designed into 'smart' computer terminals, miniature communication switching devices, versatile production machines, and an uncountable number of consumer appliances, calculating and entertainment devices.

Microprocessor 'chips' sell for as little as $10 in large quantity purchases, and when combined with various auxiliary circuits, a power supply, an input-output device, and a few control switches, they become a complete system capable of performing an almost unimagined number and variety of functions. All this is available to millions of people - from amateur hobbyists to atomic scientists for a few hundred dollars. The benefits of this technological revolution will be tremendous. Engineering productivity will increase and design cycles will shorten. Engineers will have time to focus more energy on applications - oriented solutions as opposed to chasing down logic errors in a fixed system. These advances should lead to a new generation of products which will be more cost effective, more useful, more reliable and reach the market faster.

An April 10, 1975 Survey and Report, developed by Frost and Sullivan, a major New York research firm, projected that by 1984, "...about two million minicomputers and 15 million microcomputers will be installed". A total value of the market is estimated to be $45 billion. The report further states, "A microprocessor system will sell for $100 or less, so the potential applications are mindboggling." A TRW official suggests we will soon be buying microcomputers as we would "...buy a toaster". The current rate of production of microcomputers suggests the 15 million projection will be reached well before 1984. The competition is furious, and the product prices continue to fall. New educational, entertainment and industrial markets are opening for orders in the hundreds of thousands.

None of us can afford to 'backslide' while this onrushing progress expands. The "Microcomputer Dictionary" can be one of the basic tools required to stay with it.

Charles J. Sippl

DEDICATION

Deep appreciation flows to my wife and our seven children whose patience, forebearance and encouragement were very necessary and were generously given to help maintain the persistance required to complete this volume.

Particular respect and thanks must be given to my wife, Margaret, whose valuable assistance was most significant in developing the degree of thoroughness the work demonstrates.

My appreciation and respect also flows out to the leaders of the electronics industry who have written and produced a wealth of excellent literature, including: articles, manuals, reference notes, speeches, monographs, conference reports and research project summaries, from which these terms and definitions found their origin.

Charles J. Sippl
January, 1976

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A

A and not B gate — A specific binary logic coincidence (two-input) circuit used to complete the logic operations of A AND NOT B, i.e., result is true only if statement A is true and statement B is false.

abbreviated addressing — A process of shortening the direct address mode by using only part of the full address and providing a faster means of processing data because of the specially modified code.

ABEND unrecoverable — An error condition that results in abnormal termination of a program. Contrast with recoverable ABEND.

absolute address — 1. An actual location in storage of a particular unit of data; address that the control unit can interpret directly. 2. The label assigned by the engineer to a particular storage area in the computer. 3. A pattern of characters that identifies a unique storage location or device without further modification. (Synonymous with machine address.)

absolute code — A code using absolute addresses and absolute operation codes; i.e., a code that indicates the exact location where the referenced operand is to be found or stored. (Synonymous with one-level code and specific code, and related to absolute address.)

absolute assembler — An absolute assembler calculates absolute memory addresses for every source program instruction address field.

absolute loader — A bootstrap loader, generally makes no checks for errors. Since loading unchecked programs is bad practice, the absolute loader will have various error checking capabilities. If the absolute loader loads a program without giving any error signals, users can be sure that the program is an accurate string of bytes that had previously been written out as a valid object program, but that is all. Data and programs are recorded in a rigid format, with all memory addresses previously calculated by other system software such as an absolute assembler.

absolute maximum rating — Absolute maximum rating refers to the limiting values of the operating and environmental conditions applicable to any electronic device as defined by its published data, and not to be exceeded under the worst conditions. It is a rating beyond which the reliability of a device can be expected to decline.

absolute-value device — A transducer that produces an output signal equal in magnitude to the input signal but always of one polarity.

absolute value sign — A specific horizontal line sign indicating that the absolute value of a number is to be taken, i.e., the value of the number irrespective of the sign.

absorption — Absorption is the deposition of a thin layer of gas or vapor particles onto the surface of a solid. The process is also known as chemisorption if the deposited material is bound by a chemical bond.

absorbtion current — Refers to the current flowing into a capacitor following its initial charge, due to a gradual penetration of the electric stress into the dielectric. Also relates to the current which flows out of a capacitor following its initial discharge.

acceleration time — The time between the interpretation of instructions to read or write on tape, and the transfer of information to or from the tape onto storage, or from storage into tape, as the case may be. (Synonymous with start time.)

acceptance test — This is a test to demonstrate the degree of compliance of the purchased equipment with the purchaser's requirements and specifications.

access, instantaneous — Refers to the process of obtaining data from, or placing data into a storage device or register without serial delay usually due to the in order processing of other units of data.

accumulator (AC) — The accumulator is a 4, 8, 12 or 16-bit register that functions as a holding register for arithmetic, logical, and input-output operations. Data words may be fetched from memory to the AC or from the AC into memory. Arithmetic and logical operations involve two operands, one held in the AC, the other fetched from memory. The result of an operation is retained in the AC. The AC may be cleared, complemented, tested, incremented or rotated under program control. The AC also serves as an input-output register. Programmed data transfers pass through the AC.

accuracy rating of an instrument — Refers to the limit, usually expressed as a percentage of full-scale value, not exceeded by errors when the instrument is used under reference conditions.

AC/DC — A term used to describe electronic equipment which is capable of operation from either AC or DC primary sources.

achieved reliability — Refers to reliability which is determined on the basis of actual performance or operations based on standards or benchmarks

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under equal or equivalent conditions and circumstances. Also referred to as operational reliability.

ACIA - asynchronous communications interface adapter — An Asynchronous Communications Interface Adapter provides the data formatting and control to interface serial asynchronous data communications information to bus organized systems. The bus interface of some systems includes select, enable, read/write, interrupt and bus interface logic to allow data transfer over an 8-bit bi-directional data bus. The parallel data of the bus system is serially transmitted and received by the asynchronous data interface, with proper formatting and error checking. The functional configuration of the ACIA is programmed via the data bus during system initialization. A programmable Control Register provides variable word lengths, clock division ratios, transmit control, receive control and interrupt control. In peripheral or modem operation several control lines are provided. These lines allow the ACIA to interface directly with the digital modem.

active element — 1. An element in its excited or being used state, i.e., a tube, transistor or device which is on or alive rather than off, dead or in a ground state. 2. A file, record or routine which is being used, contacted, or referred to. Computing components are active when they are directed or excited by the control unit.

active transducer — Any transducer in which the applied power controls or modulates locally supplied power, which becomes the transmitted signal, as in a modulator, radio transmitter.

adapter — A connective device designed to affect operative capability between different parts of one or more systems and/or subsystems.

adapter plug — Refers to a fitting designed to change the terminal arrangement of a jack, socket, or other receptacle, so that other than the original electrical connections are possible.

A/D analog-digital converter — Circuit used to convert information in analog form into digital form (or vice versa), e.g., in a digital voltmeter, and other devices.

A/D converter controller — In operation several analog inputs are connected to an analog-digital (A/D) convertor through an analog multiplexer. The controller selects an analog channel for conversion by the A/D convertor. When conversion is complete, the END OF CONVERSION signal is asserted. The converted signal binary value is then read into the controller for processing. Errors are tested for, and out-of-circuit checks are performed on the digital representation of the analog signal.

adder — A device that forms as an output, the sum of two or more numbers presented as inputs. Often no data retention feature is included; i.e., the output signal remains only as long as the input signals are present.

adder-accumulator — In some systems the adder is a 4-bit parallel binary adder with an internally connected carry or implementing precision arithmetic operations. The adder operates with the 4-bit accumulator form the Arithmetic Logic Unit (ALU) section of the CPU. Functionally, the CPU has ten or more microinstructions dedicated to arithmetic and logical operations. All can be one-cycle instructions and can enable direct arithmetic operation between the accumulator and the data stored in RAM or ROM storage. In addition to its arithmetic functions, the accumulator is the primary working register in the CPU and is the central data interchange point for most all data transfer operations occurring in the system. During internal data transfer the accumulator is the interfacing data register for both RAM and ROM. For external data exchanges (Input/Output) the accumulator is the source of the output data and the receiver register for the input data.

adder two-input — A logic element which performs addition by accepting two digital input signals (a digit of a number and an addend or a carry) and which provides two output signals (a carry digit and a digit for the sum).

addition time, microprocessor — Register-to-register addition time is a popular estimate of the computing speed of a computer. This specific instruction is often chosen as a selection factor because nearly every computer has a comparable add instruction. Microprocessors with more than one programmer-accessible register for data manipulation on the CPU chip can usually perform a fast register-addition in a minimum instruction execution time. Some processors, however, are organized as one-accumulator computers so that register-to-register additions are not provided. In these cases the addition of the contents of an arbitrary storage location to the accumulator is often scored as the minimum addition time. The incrementing of a register by one is not considered a good test of addition time. Addition time should not be the only criterion used in timing estimation. Some computer makers have been known to treat that one instruction uniquely so that the machine appears to the casual observer to be faster than it really is.

address — 1. A character or group of characters that identifies a register, a particular part of storage, or some other data source or destination. 2. To refer to a device or an item of data by its address.

addresses, memory — Every word in memory has a unique address. A word may be defined as a set of bits comprising the largest addressable unit of information in a programmable memory. The address of a word is its location in memory.

address format — 1. The arrangement of the address parts of an instruction. The expression "plus-one" is frequently used to indicate that one of the addresses specfies the location of the next instruction to be executed. Such as one-plus-one, two-plus-one, three-plus-one, four-plus-one. 2. The arrangement of the parts of a single address such as those required for identifying channel, module, track, etc. in a disc system.

addressing capabilities — Much of the power of microcomputers is derived from wide ranges of addressing capabilities. Addressing modes include

sequential forward or backward addressing, address indexing, indirect addressing, 16-bit word addressing, 8-bit byte addressing, and stack addressing. Variable-length instruction formatting allows a minimum number of words to be used for each addressing mode. The result is efficient use of program storage space.

addressing capacity, microprocessor — Programming addressing range determines how large a program can be written without resorting to special external hardware and internal software techniques. A range that is too small means that extra hardware will be required to extend the addressing. Excessive capacity means that extraneous address bits will be carried in every instruction that refers to storage.

addressing concepts, microprocessor — The addressing of data and program segments in CPU storage is a concept that presents enormous variations from computer to computer. The problem is to allow references to be made to any arbitrary word in the addressing space, yet eliminate the need for a full set of address bits in each and every instruction. If the full address is required in each instruction, program sizes tend to grow. Most microprocessors take advantage of the fact that most data and program references are local in scope; that is, references are most often close to the address of the current instruction being executed or close to the last datum referenced in main storage. Various microprocessor vendors tend to adopt a unique vocabulary for describing address utilization.

addressing level — 1. Zero level addressing, the address part of an instruction is the operand, for instance, the addresses of shift instructions, or where the address is the date (in interpretive or generating systems). 2. First level addressing, the address of an instruction is the location in memory where the operand may be found or is to be stored. 3. Second level of addressing (indirect addressing), the address part of an instruction is the location in memory where the address of the operand may be found or is to be stored.

addressing modes — Data stored in memory must be accessed and manipulated. Data handling is specified by instructions such as (MOV, ADD, etc.) which usually indicate: The function (operation code); a general-purpose register is to be used when locating the source operand and/or a general-purpose register is to be used when locating the destination operand; an addressing mode (to specify how the selected register(s) is/are to be used. A large portion of the data handled by a computer is usually structured (in character strings, arrays, lists, etc.). Addressing modes provide for efficient and flexible handling of structured data. The general registers may be used with an instruction in any of the following ways: As accumulators, the data to be manipulated resides within the register. As pointers, the contents of the register is the address of the operand, rather than the operand itself, and as index registers.

addressing modes, microprocessor — Common addressing modes include direct, immediate and indirect. In the immediate mode, the instruction includes data, while in the indirect mode, an address preloaded into a register increases the address bits in an instruction. Variations and extensions of these modes are also used, so a basic instruction can be manipulated several times and ways.

addressing, symbolic — Refers to a fundamental procedure or method of addressing using an address (symbolic address) chosen for convenience in programming or of the programmer in which translation of the symbolic address into an absolute address is required before it can be used in the computer.

address modification — Address modification is a change in the address portion of an instruction or command. Usually, if the routine which contains that instruction or command is repeated, the computer will go on to a new address or location for additional data and/or instructions.

address part — Refers to a computer instruction or a portion of an expression designating location.

address path, microprocessor — The address path is the selection path for memory and I/O data. For data processing, memory and I/O often use separate addressing or selection schemes. This suits the need for maximum memory and extensive peripherals. For logic processors, a combined addressing path for memory and I/O is the most efficient. Interconnection is simplified and the package pin limitation is not overextended.

address selection logic, microcontroller — Basically, addresses are decoded to select the internal word count register, bus address register, data input and output registers, or the user-designed command and status register, for output to the bus interface. Logic includes receivers, inverters, decoder, and logic to provide a synchronizing pulse under control of an external master device. The registers are decoded in various sequential addresses. Ten or more input lines may be strapped through wire-wrap posts to form the enabling address to the decoder. A sequence of output sync pulses is provided to notify the CPU of device addressing and for loading registers, etc., after the user address is detected and the master device asserts a command pulse.

address, single level — An address that indicates the location where the referenced operand is to be found or stored with no reference to an index register or B-box. (Synonymous with first-level address.)

address, symbolic — Arbitrary identification of a particular word, function, or other information without regard to the location of the information.

address, track — Binary codes on magnetic tape or disc to locate data stored in other tracks by actual code patterns as indicated by the address, or by completing a count, or by simply noting their positions.

address, two-plus-one — Pertaining to an instruction that contains two operand addresses and one control address.

address types — An address is a coded designation of the instruction or of the location of data or program segments in memory. The address may refer to storage in registers or the many types of memories. The address code itself may be stored so that a location may contain the address of data rather than the data itself. This form of addressing is quite common in microprocessors, but there is considerable variation due to the efforts to reduce execution time.

add-subtract time — Refers to the time required by a digital computer to perform addition or subtraction, not including the time required to obtain the quantities from storage and put the result back into storage.

add time, (in microseconds) — The time required to acquire from memory and execute one fixed-point add instruction using all features such as over-lapped memory banks, instruction look-ahead and parallel execution. The add is either from one full word in memory to a register, or from memory to memory; but not from register to register.

A/D interface — Several firms offer a "Building Block" subsystem useful for implementation of the analog to digital conversion (ADC) function. The devices permit the construction of high performance ADCs at a fraction of the cost of comparable modular units. With this subsystem, the critical analog processing is done on the monolithic chip and the less critical digital system of counters and gates is left for the system designer to implement.

alarm systems, microprocessor — CPUs scan input-output points at preselected intervals. When the A conversion is completed, data are read, processed, and checked against alarm limits. Critical deviations from normal operating conditions are detected and alarms are sent to the control/acknowledgement terminal. The CPU at the terminal formats and routes the alarm data to an operator's display panel. The operator on duty observes the detected alarm and takes the necessary steps to correct the problem.

Alarms corresponding to "crisis" situations, can be detected direcly by limit switches, circuit-continuity breaks or by the manual depression of a button. Examples include floods, fire, burglary or accidents. These conditions require immediate attention and would therefore be assigned as priority vector interrupts in the CPU monitor.

ALGOL — One of the international program languages designed for the concise, efficient expression of arithmetic and logical processes and the control (iterative, etc.) of these processes. Taken from ALGOrithmic Language.

algorithm — A prescribed set of well-defined rules or processes for the solution of a problem in a finite number of steps, for example, a full statement of an arithmetic procedure for evaluating sin x to a stated precision. Contrast with heuristic.

algorithmic language program conversion — Several results are involved in converting to machine language program. Among these are: decomposition of syntactic structure, allocation of storage, production of target program, editorial and optimizational function, diagnostic provisions, etc.

algorithm, transfer — A specific algorithm design used in a demand fetching system to determine the order in which segments demanded by concurrent processes are transferred from a backing store to an internal memory.

alignment — The process of adjusting components of a system for proper interrelationship. The term is applied especially to the synchronization of components in a system.

alignment pin — Refers to any pin or device that will insure the correct mating of two components designed to be connected.

allocate — Refers to assignment of storage in a computer to main routines and subroutines, thus fixing the absolute values of symbolic addresses.

alloy — Refers to a composition of two or more elements, of which at least one is a metal. It may be either a solid, solution, a heterogeneous mixture, or a combination of both.

alphabetic coding — A system of abbreviation used in preparing information for input into a computer. Information may then be reported in the form of letters and words as well as in numbers.

alphanumerics, displays, gas discharge — Each glowing dot in most gas discharge displays produces a light output that exceeds 300 microcandelas, which makes the characters easy to read and viewable in high ambient light. Some gas discharge panels are only 14 inches long, 2 inches high and less than an inch deep. These displays are suitable for point-of-sale and moving message applications, and can be used in large audience information systems.

alternating-charge characteristic — Refers to the functions relating, under steady-state conditions, the instantaneous values of the alternating component of transferred charge to the corresponding instantaneous values of a specified periodic voltage applied to a nonlinear capacitor.

alternating current — Electric current whose flow alternates in direction; the time of flow in one direction is a half-period, and the length of all half-periods is the same. The normal waveform of a.c. is sinusoidal, which allows simple vector algebraic treatment. Provided by alternators and valve oscillators.

alternation — Refers to one half of a cycle, either when an alternating current goes from positive to zero or from negative to zero. Two alternations make one cycle.

alter switch — The alter switch, when toggled, causes the contents of the switch register to be copied into the register selected by the display switch, or the memory location contained in the program counter if the display switch is so set.

ALU architecture — A microprocessor can constitute the ALU (Arithmetic-Logic Unit) and control portions of a general-purpose computer. However, because of the different objectives of each manufacturer, architectures vary widely. For example, one major system has only two eight-bit programmer-

accessible data registers in the CPU, while another processor has an eight-bit accumulator and 64 eight-bit data registers. Generally, the ALU handles eight-bit quantities through the accumulator, and the register file is composed of three sixteen-bit registers. Because the accumulator and ALU are often only eight bits wide, these three general registers can be accessed by insructions that treat them as six eight-bit registers. The choice of concept is often up to the programmer. From a hardware standpoint, the processor on many systems operates on eight-bit bytes and all I/O operations use an eight-bit data path.

ALU (Arithmetic-Logic Unit) — The ALU is the heart of and one of the essential components of a microprocessor. It is the operative base between the registers and the control block. The ALU performs various forms of addition, subtraction, and the extension of these to multiplication, division, exponentiation, etc. The logic mode relates to the operations of gating, masking and other manipulations of the contents of registers.

aluminum gate and silicon gate differences — An intrinsic determinant of v_t is the choice of gate electrode and substrate materials. This relates to the physics concept of work function, which represents the binding energy of an electron in a particular material. When polycrystalline doped silicon is used as a gate electrode instead of aluminum, the work function changes in such a way as to cause a lower v_t. This is the basic difference between aluminum gate and silicon gate processes.

ambient conditions — Ambient conditions are the conditions of the surrounding medium (pressure, noise, etc.).

American Federation of Information Processing Societies (AFIPS) — Headquarters - Montvale, N.J. An organization of computer related societies. Its members include: The Association for Computer Machinery; The Institute of Electrical and Electronic Engineers Computer Group; Simulation Councils, Inc.; American Society for Information Science. Its affiliates include: American Institute of Certified Public Accountants; American Statistical Association; Association for Computational Linguistics; Society for Industrial and Applied Mathematics; Society for Information Display, Association of Data Processing Services Organizations.

American National Standard control characters — Control characters defined by America National Standard FORTRAN, ANSI X3.9-1966, Synonymous with ASCII control character, FORTRAN control character.

American National Standards Institute (ANSI) — Formerly American Standards Association (ASI) and, prior to that, United States of America Standards Institute (USASI), this organization organizes committees formed of computer users, manufacturers, etc., to develop and publish industry standards, e.g., ANSI FORTRAN, ANSI Standard Code for Periodical Identification, etc.

American Standard Code for Information Interchange (ASCII) — Usually pronounced "ASKEE." A standard data-transmission code that was introduced to achieve compatibility between data devices. It consists of 7 information bits and 1 parity bit for error-checking purposes, thus allowing 128 code combinations. If the eighth bit is not used for parity, 256 code combinations are possible.

ampere — Refers to a unit of electrical current or rate of flow of electrons. One volt across one ohm of resistance causes a current flow of one ampere. A flow of 1 coulomb per second equals 1 ampere. An unvarying current is passed through a solution of silver nitrate of standard concentration at a fixed temperature. A current that deposits silver at the rate of .001118 grams per second is equal to 1 ampere, or 6.25×10^{18} electrons per second passing a given point in a circuit.

amplification power — 1. That provided by valves when delivering power, as contrasted with voltage amplification. 2. Difference between output and input power levels of an amplifier, expressed in decibels.

amplifier — Device for controlling power from a source so that more is delivered at the output than is supplied at the input. Source of power may be mechanical, hydraulic, pneumatic, electric, etc. Electric amplifiers may be classified into (1) valve, which operates on voltage, (2) repeater, specially used for telephone circuits, (3) transistor, which operates on current, (4) magnetic, which operates on very low-frequency currents, (5) solid state, operated by transistor action in a single semiconductor block.

amplifier, transistor — One which uses transistors as the source of current amplification. Depending on impedance considerations, there are three types: base, emitter or collector grounded.

amplifier, tuned — One containing tuned circuits, and therefore sharply responsive to particular frequencies.

amplitude distortion — A condition that occurs in an amplifier or other device, when the output amplitude is not a linear function of the input amplitude. Amplitude distortion should be measured with the system operating under steady-state conditions and with a sinusoidal input signal. When other frequencies are present, the term "amplitude" applies to the fundamental only.

amplitude modulation — Abbreviated AM. Refers to a process by which a constant frequency is varied in amplitude by a signal or intelligence frequency. In this manner, the envelope of the constant frequency bears a direct relationship to the signal or intelligence frequency.

analog — In electronic computers, the term refers to a physical system in which the performance of measurements yields information concerning a class of mathematical problems.

analog amplifier — In some systems the Analog Amplifier performs two functions. First, it supplies the dual-delayed sweep comparators with the proper dc levels. Second, it accepts the dc level from the verti-

cal channel, processes this level and provides two pieces of information for the processor through the input interface. The two pieces are the polarity of the dc level and whether the level is greater or lesser than some reference. If it is greater, the processor increases the reference until it is within 1 LSB of the unknown. Conversely, if it is lesser: the processor decreases the reference until it is within 1 LSB of the unknown. In both cases, it displays the reference level that is now equal to the unknown.

analog channel — A computer channel in which transmitted information can have any value between the defined limits of the channel.

analog computer — A computer which operates on the principle of creating a physical (usually electrical) analogy of a mathematical problem to be solved. Variables such as temperature or flow are represented by the magnitude of a physical phenomenon such as voltage or current. These variables are manipulated by the computer in accordance with mathematical formulas "analoged" on it.

analog modules, testing (small systems) — A four digit BCD Digital to Analog convertor module is needed to test any Analog to Digital module. Another way of testing an Analog to Digital module is by supplying 0 VDC through 10 VDC and see the binary equivalent on the console lights; in this case a power supply is needed. Digital to Analog converter modules can be tested, using a scope.

analog output — As opposed to digital output, the amplitude is continuously proportionate to the stimulus, the proportionality being limited by the resolution of the device.

analog recording — In the broadest sense, analog recording is a method of recording in which some characteristics of the record current, such as amplitude or frequency, is continuously varied in a manner analogous to the time variation.

analog representation — A representation having discrete values but continuously variable.

analog-to-digital-converter (ADC) — Refers to a device which produces a digital output from an input in the analog form of physical motion or electrical voltages.

analytic relationship — The relationship which exists between concepts and their corresponding terms, by their definition and inherent scope of meaning.

analyzer, electronic differential — A form of analog computer using interconnected electronic integrators to solve differential equations.

ancillary equipment — A term which is often interchangeable with peripheral equipment which relates to all types of input-output, communication and interface equipment.

AND — A logical operator which has the property such that if X and Y are two logic variables, then the function "X AND Y" is defined by the following table:

X	Y	X and Y	X	Y	X and Y
0	0	0	1	0	0
0	1	0	1	1	1

The AND operator is usually represented in electrical notation by a centered dot ".", and in FORTRAN programming notation by an asterisk"*" within a Boolean expression.

AND element — One of the basic logic elements (gates or operators) which has at least two binary input signals and a single binary output signal. The answer or variable which represents the output signal is the conjunction (set theory) of the variables represented by the input signals.

AND gate — Refers to a gate circuit in an electronic computer with more than one control (input) terminal. No output signal will be produced unless a pulse is applied to all inputs simultaneously.

'AND' operation — A basic operation in Boolean algebra is the AND operation which, for the two integers I and J, may be defined by the statement:

If I and J are both 1, then the result is 1. Otherwise the result is zero.

Three possible combinations of 0 and 1 for the AND operation are:

ADD Add the contents of the memory byte to the accumulator. Consider the logical sequence whereby the computer will perform binary addition. Recall that:

$$0 + 0 = 0$$
$$0 + 1 = 1$$
$$1 + 0 = 1$$
$$1 + 1 = 0 + (\text{carry})$$

Logical rules to determine the status of each accumulator bit are given in various tables.

$$0 \bullet 0 = 0$$
$$0 \bullet 1 = 0$$
$$1 \bullet 0 = 0$$
$$1 \bullet 1 = 1$$

The dot is used to indicate the AND operation. When letters are used (in general cases), the dot is sometimes ommitted:

I and J may be represented by I•J or IJ.

The AND gate truth table is given below:

$$0 + 0 = 0$$
$$0 + 1 = 1$$
$$1 + 0 = 1$$
$$1 + 1 = 1$$

In other notation the AND operation is the logical operation applied to two operands which will produce an outcome depending on the bit patterns of the operands and according to rules for each bit position. For example, p = 110110, q = 011010, then r = 010010.

AND operator — 1. A logical operator that has the property that if P is a statement and Q is a statement, then P AND Q are true if both statements are true, false if either is false or both are false. Truth is normally expressed by the value 1, falsity by 0. The AND operator is often represented by a centered dot (P • Q), by no sign (PQ), by an inverted "u" or logical product symbol ($P \wedge Q$), or by the letter "X" or multiplication symbol (P x Q). Note that the

letters AND are capitalized to differentiate between the logical operator and the word 'and' in common usage. 2. The logical operation that makes use of the AND operator or logical product.

ANSI (American National Standards Institute) — formerly ASA and USASI, an organization that develops and publishes industry standards.

anticoincidence circuit — Refers to a counter circuit that produces an output pulse when either of two input circuits receives a pulse, but not when the two inputs receive pulses at the same time.

anticoincidence unit — A binary logic coincidence circuit for completing the logic operation of exclusive-OR, i.e., the result is true when A is true and B is false or when A is false and B is true and the result is false when A and B are both true or when A and B are both false. Same as difference gate, nonequivalence gate, distance gate, diversity gate, add-without carry gate, exjunction gate, nonequality gate, symmetric difference gate, partial sum gate, and modulo-two sum gate.

APL language — a programming language developed by Iverson. An unusually extensive set of operators and data structures are used to implement what is considered by many to be the most flexible, powerful, and concise algorithmic/procedural language in existence. Primarily used from conversational terminals, its applicability to "production" job processing is limited but its value for educational and investigative work is great.

apparent power — The product of the root-mean-square value of the current and the root-mean-square value of the voltage.

application notes, microcomputer — Application notes are a particular form of documentation endemic to the semiconductor business; they are not common in the community of computer vendors. However, the rapid engineering changes and problems of designing microprocessors into final systems virtually require the use of application notes for release rapidity. Some microprocessor vendors publish one circuit diagram. Others publish alternative ways of accomplishing the same objectives, complete with hardware and software considerations.

application package — A set of computer programs and/or subroutines used to solve problems in a particular application, i.e., business, scientific, financial, etc.

applications, microprocessor-controlled terminals — Microprocessors tend to control all functions in terminals that they can, for example, the CRT is hardware generated; the terminal can have RAM display memory; the processor can directly control the cursor; the processor can directly control the I/O. Debugging routines, register and memory dumps, memory data modification, and breakpoint insertion capabilities are a few of the other microprocessor control characteristics of 'intelligent' terminals.

applications program — A program written to accomplish a specific user task (such as payroll) as opposed to supervisory, general purpose, or utility program.

applications programs preparations (cost) — Preparation of applications programs can be broken down into the following steps:

1. Write the source program. The cost of this step will be proportional to the length of the program, and therefore will be a function of the memory required by the CPU. A good operating system will further reduce the size of source programs by providing commonly used subroutines such as mathematical functions, input/output drivers, and program execution scheduling.

2. Generate an object program. Costs will be insignificant for this step if the user is programming in a higher level language. If the source program is in assembly language, a relocatable assembler and linking loader will provide a significant saving over an absolute assembler and loader.

3. Debug the object program. The cost of this step will be determined by the debug system software provided.

applications support — Applications support packages assist users in: (1) evaluating the operation of the microcomputer family of parts in an actual application, (2) reducing the engineering time and development costs required in developing and constructing prototype systems using the microcomputer family of parts, (3) comparing user's system software and firmware programs, (4) reducing the time required to evaluate and debug system hardware, software and firmware, (5) providing a working model of the user's system.

application study — The detailed process of determining a system or set of procedures for using a computer for definite functions or operations, and establishing specifications to be used as a base for the selection of equipment suitable to the specific needs.

APT (Automatically Programmed Tools) — A language for programming numerically controlled machine tools. ANSI standard is close to approval. There are many other similar languages with different names.

APT III — APT is a system for the computer-assisted programming of numerically controlled machine tools such as flame cutters, drafting machines and similar equipment. It is production-oriented, that is, it was written to simplify the effort, time and money needed to take full advantage of numerically controlled techniques in engineering and manufacturing. In addition to providing machine-tool programming capabilities virtually impossible by manual methods, ALU can also shift by 3 positions to implement a byte in numerical control: reduced lead time; greater design freedom and flexibility; lower direct costs; greater accuracy; improved production forecasting; lower tooling costs; better engineering control of the manufacturing process; and simplified introduction of changes. The APT III program represents over one hundred man years of development and testing.

arbitrary-function generator — A specific function

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