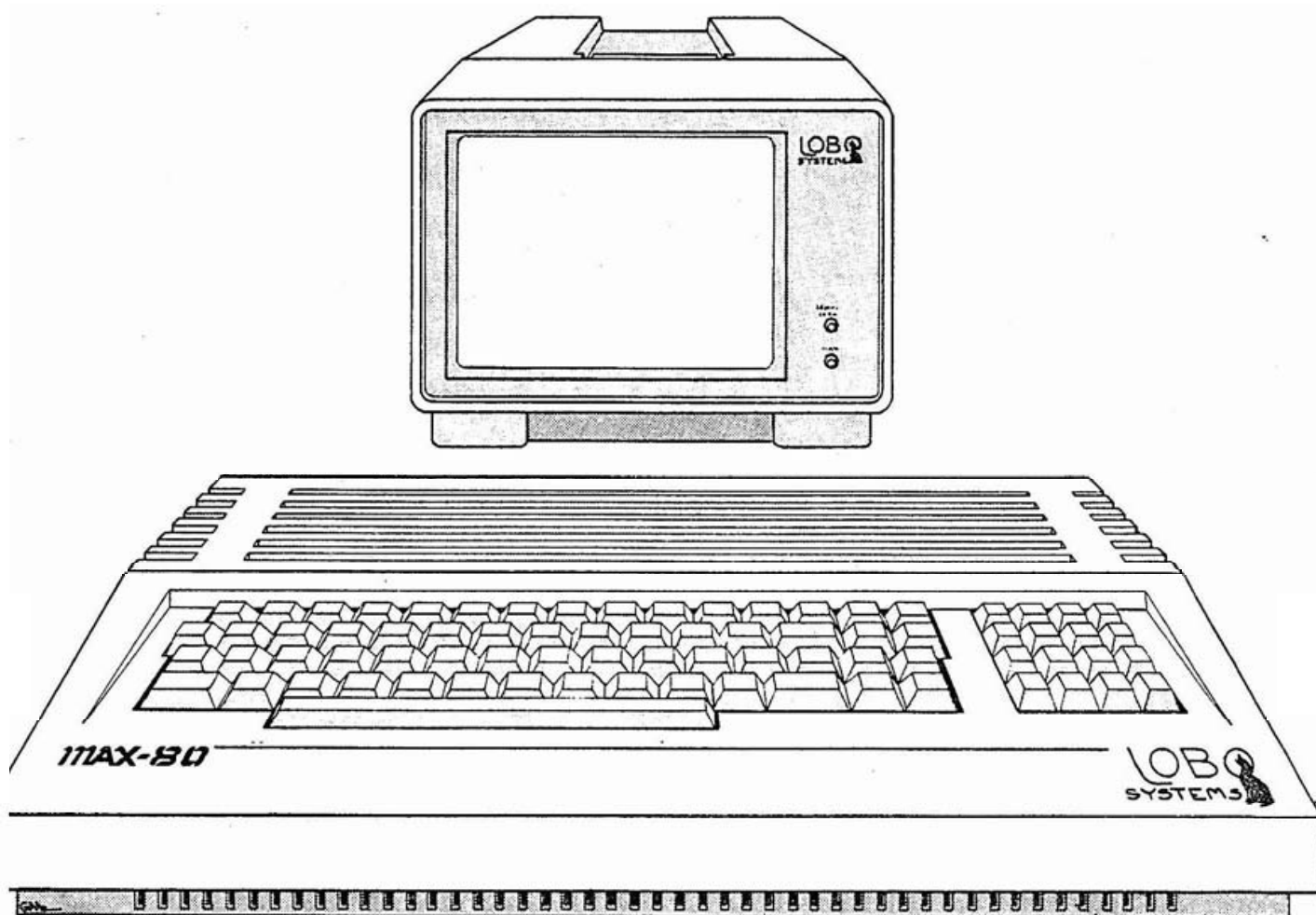


# MAX-80



## OPERATION MANUAL

358 SOUTH FAIRVIEW AVE., GOLETA, CALIFORNIA 93117 (805) 683-1576 TELEX 658 482

## MAX-80 OPERATION MANUAL

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#### MAX-80

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LOBO SYSTEMS

VERSION 2.1

# MAX-80 OPERATION MANUAL

LOBO SYSTEMS

VERSION 2.1

MAX-80 OPERATION MANUAL

INTRODUCTION

TABLE OF CONTENTS

INTRODUCTION . . . . .	INTRO-1
Standard Features of the MAX-80 . . . . .	INTRO-3
The MAX-80 Philosophy of Documentation . . .	INTRO-6
About This Manual . . . . .	INTRO-7
And If? . . . . .	INTRO-8
Manual Overview . . . . .	INTRO-9
GLOSSARY . . . . .	INTRO-13

MAX-80 OPERATION MANUAL

CONTENTS

LOBO SYSTEMS

viii

VERSION 2.1



# INTRODUCTION

The MAX-80 business computer is an exceptional small computer.

It works much faster than the vast majority of microcomputer systems (including many of the much more expensive 8 and 16 bit computers).

It can accomodate a complete range of disk drives, from 3-1/2 inch microfloppies to large 10 Megabyte hard drives. It can even run up to nine drives at a time -- that is, it can keep a very large amount of information on hand, ready for instant access.

It can operate a huge number of different software packages. With its standard operating system, the MAX-80 can run programs from the world's largest collection of software, the CP/M software base. With the other operating systems available for it (DOSPLUS, LDOS and MULTIDOS), the MAX-80 can also use programs from one of the other extremely large bases of software.

It includes, standard, all of the hardware necessary for controlling a variety of computer accessories -- letter quality and high speed printers, graphics plotters, telephone communications modems, speech synthesizers, scientific and engineering instrumentation, industrial equipment controllers, even appliance control modules for turning appliances on and off.

It is fully reconfigurable. The shapes of the letters and graphics characters used on its video screen may be completely changed; all of the keys on its keyboard may be redefined; its commands may be shortened to a single keystroke by the use of its function keys.

And, to top it all, the MAX-80 is one of the least expensive business computers on the market.

TO MAKE THE BEST USE OF THE MAX-80, YOU MUST KNOW HOW TO RUN IT.

This manual is the MAX-80 Operations Manual. It describes how to set up your MAX-80 hardware, how to install its standard CP/M Plus (CP/M 3) operating system, how to use the Lobo utilities that were written especially for the MAX-80, and how to install applications software (the kind you need to really do things) on CP/M Plus.

This section of the manual presents overall descriptions of the MAX-80 and its standard CP/M operating system. It also gives a brief glossary of computer terms that are all too often bandied about without adequate definition. (Please note: we make no claim to having the official definitions of any of these terms. These definitions are only what we mean when we bandy these terms about.)

## STANDARD FEATURES OF THE MAX-80

**MAXIMUM SPEED:** The Z-80B microprocessor (that is the heart of the MAX-80) runs at 5 MHz (5 million cycles per second). This is over double the speed of most of the popular microcomputers sold today, and significantly faster than most of the rest. The MAX-80's working output (determined in terms of the speed at which a program processes data) is actually greater than some of the so-called 16 bit microcomputers selling for hundreds of dollars more.

What does this mean to you? It means that word processors respond faster to your editing commands, spreadsheets recalculate more quickly, programs run with less of your waiting around, and less time is required for practically everything else. In short, since time is money, it means money saved.

**MAXIMUM INTERNAL MEMORY:** 128K RAM (Random Access Memory) is a standard feature of the MAX-80. This is at least double (and frequently more than double) the amount of internal memory that is provided with most other microcomputers, including business microcomputers. (Even many of the 16 bit computers come standard with only 64K RAM.)

Meaning? Meaning that programs can be made to run faster than they do with just a fast microprocessor. Meaning even more money saved.

**MAXIMUM FLOPPY DISK DRIVE EXPANSION:** The standard MAX-80 contains controller interfaces for four 5-1/4 inch and four 8 inch floppy disk drives. The built-in floppy disk controller is capable of reading and writing in single- or double-sided and single- or double-density formats in all of the standard microcomputer floppy disk sizes. This produces both maximum compatibility with other computer systems and maximum storage capacity.

Meaning? Compatibility with other computer systems means that more software is available to do what you want to do with the MAX-80. More software means a greater variety of software. And a greater variety means that it is more likely you will find the software that does exactly what you want. Storage capacity means

that you can have more information at hand -- so either you will have to go searching for the right information less often, or your searches will be finished faster, or both. Again, money saved.

**FIXED DISK EXPANSION:** In addition to the floppy drive interfaces, the MAX-80 includes (again standard) a Winchester interface for the attachment of a fixed disk drive. Either a Lobo Systems UVC or a SASI fixed disk system can be run from this interface. (For definitions of this jargon, see the glossary at the end of this section.) To connect a non-Lobo drive that is SASI compatible, it is necessary to modify the Lobo disk controller software. (Because, even though SASI is a standard, there still is a lot of variation both in Winchester drives and in Winchester drive controllers.)

Fixed disks cost more than floppies, but they store much more information and retrieve that information faster. So an initial investment pays off in dividends. (Many other computers can't even talk to large 8 inch floppy drives, much less Winchesters.)

**MAXIMUM COMMUNICATIONS:** Two RS-232C serial ports with independent baud rates are standard on the MAX-80, as is a Centronics-compatible parallel printer port. These three ports allow maximum interfacing to most printers, plotters, modems and speech synthesizers.

A computer specializes in communications. Cars specialize in transportation, houses specialize in shelter, governments specialize in taxes. But for computers it's communications. So the more ways a computer has to communicate, the more ways you have to communicate: words on the screen (CRTs), words on paper (printers), pictures on paper (plotters), words and pictures over telephone lines (modems), words in the air (speech synthesizers). The MAX-80 communicates with a very large variety of these devices. Meaning that you can more easily find the exact device that says what you want to say -- or tells you what you want to hear. With the MAX-80 you can frequently get more than what you pay for.

**MAXIMUM REDEFINABILITY:** The MAX-80 is capable of displaying on a video screen 192 different character shapes at a time. Any or all of these shapes can be redefined. The MAX-80 has 76 keys on its keyboard. The letters associated with any or all of these keys can be rearranged.

Don't like the characters you see on the screen? Change them. Don't like the locations of the keys on the keyboard? Change them. Dissatisfaction slows things down. Satisfaction speeds things up. The MAX-80 can't guarantee satisfaction. But it can make the chances a lot better.

**MAXIMUM RELIABILITY:** No extra boards or hardware modifications are required in order to make the MAX-80 do what the small business needs. The MAX-80 requires no special video boards, no extra RAM boards, no extra controller boards, no extra processor boards, no extra keyboard enhancement boards. Once a compatible disk drive (and most disk drives are compatible) has been plugged in, the MAX-80 is ready to run any of the variety of operating systems set up for it (including CP/M Plus, DOSPLUS, LDOS, and MULTIDOS). You won't have to worry about multiple hardware manufacturers -- or multiple hardware warranties. There is just one hardware warranty -- the Lobo Systems one year, all parts, all labor warranty.

We could not afford to warrant the MAX for a full year if the reliability weren't built in. It is interesting that other manufacturers don't have full year warranties. But it is more interesting that you can expect your MAX to keep running, without downtimes, for much more than a single year. That means more effective work time. What else could a small business want?

WELL, HOW ABOUT DOCUMENTATION?

Glad you asked, since that's the subject of the next section.

## THE MAX-80 PHILOSOPHY OF DOCUMENTATION

It is one of Lobo's goals to provide the MAX-80 owner with as much information as possible about the MAX-80 system. We therefore provide descriptions not only of the computer's startup procedures and system utilities, but also complete documentation of every major chip on its circuit boards and of every facet of its primary operating system CP/M Plus. The documentation is in every case at least equal to the documentation used by Lobo's logic designers when they designed the MAX-80 hardware and by Lobo's software engineers when they installed the CP/M Plus operating system. Frequently this documentation is better than what they had to work with -- the manuals having often been rewritten and reprinted in the meantime.

Why all this support? Two reasons: beliefs and objectives.

**Beliefs.** We believe that we should be as open as possible, consistent with our survival. We do not either expect or intend to make a lot of money by discovering some special means of doing something and then keeping it secret so that everyone has to come to us in order be able to use it. The MAX-80 is no secret. It uses high technology hardware and high quality software, but the techniques and knowledge involved are not privy to us. Our income from the MAX comes because it is a genuinely good value. We therefore believe that we can survive in this competitive market even though we fully publish its hardware design and software sources (at least, all of the ones that we authored).

**Objectives.** We are not interested in selling a lot of computers that are not used -- especially if they aren't used because no one can get the necessary information. Conversely, we frequently are happily suprised to find that someone has figured a new and better way to use one of our computers. One of the pleasures of being a computer manufacturer. But we can attain those objectives only if we give the person who is going to do the work all the information we can.

So, for both reasons, we provide very extensive documentation of the MAX-80.

## ABOUT THIS MANUAL

The MAX-80 is a powerful machine. It can do more than most microcomputers. So there are more things that can be done with it than with most microcomputers.

That is, there must be more description of what it can do. There must be more description of what you can do with it. There must be a huge manual.

Presenting: The MAX-80 Operation Manual.

This manual is large -- not because anything described in it is complicated, and not because great detail is required to do every job -- but because the MAX-80 does so much.

Take a computer that can send and receive information from four 3-1/2 inch or 5-1/4 inch drives. And from four 8 inch drives. And from a 5 or 10 Megabyte Winchester drive. Plus connections to parallel printers. And to serial devices (more printers or modems). And to miscellaneous (unknown) controllers. Plus total reconfigurability of the characters put up on the video screen. And reconfigurability of the keyboard. And 12 function keys (in CP/M). My word, even the cursor is changeable.

Describe all that, will you? Well, we tried. And all these words are the result.

In truth, it is easy to set up any one of the things the MAX can do. It even is easy to describe how to set them up. But by the time all of those descriptions are put together, you have what you see before you now -- a manual that is several hundred pages long.

YOU DO NOT HAVE TO READ ALL THESE PAGES. Thankfully.

But you do have to read some of them. Which ones, depends on what you want to do -- and how much you already know.

Even if you do know a lot about computers, we STRONGLY advise that you review the beginning setup sections of the manual. You might have run computers for many years, but it is doubtful that you have spent that much time setting up computers.

Remember, the MAX is not a simple all-in-one computer box. It can be set up in many different ways; therefore, it can be set up in many different wrong ways. You can have a time-wasting and frustrating experience trying to track down just one little thing you missed when you set your system up. Consequently, you can have a time-saving (and frustration preventing) experience to set things up the right way the first time.

Take your time, follow the procedures in this manual carefully, and you will find that your MAX-80 will be up and running in very little time.

#### AND IF?

However, if you have read and followed the instructions in this manual and still have questions or problems, then call Lobo's Technical Information Office at (805) 683-1576. Our technical support staff is happy to assist you. But, please, first make every attempt to become familiar with this manual and with your new computer.

(One of our chief frustrations is helping someone who has not even attempted to read the manual, while someone else who has genuine problems is kept waiting. So, believe us, we really appreciate it when you have read the (relevant parts of the) manual, and know what we're talking about when we ask you diagnostic questions. Thanks.)



## MANUAL OVERVIEW

The MAX-80 Operation Manual is composed of four separate, and largely independent, manuals: Hardware Setup, CP/M Startup, System Utilities and Software Installation, and the Technical Reference Manual.

Hardware Setup Manual

The hardware setup starts with the unpacking instructions and continues through to the final hardware installation and diskette care. We know the temptation is great to set this manual aside and just have a go at it, but therein lies the path to much frustration. Experienced and inexperienced computer users alike still need to learn the details of the MAX-80.

If you do not intend to use CP/M, but plan to work exclusively on one or more of the other operating systems that are available for the MAX, then the Hardware Setup manual is the only one of the manuals that you will have to read. (Eventually the Technical Reference Manual may become a necessity for some future project, but that will be some time after you have mastered the other operating system.) You can now turn to the respective operating system manual.

CP/M Startup Manual

Once your MAX-80 hardware is set up, you can begin with the operating system. This manual first introduces you to the proper "boot up" procedures for CP/M, and then, when your system software diskette is booted, it shows you how to make a backup copy of your system diskette.

Lobo Systems has written special installation utilities that are not on standard CP/M diskettes. This manual will introduce you to the utilities that are necessary if you want to change the operating system -- whether for other equipment that you are attaching to your MAX, or just for your own style (keyboard reconfiguration, character set redefinition, even cursor redesign).

System Utilities and Software Installation Manual

This manual describes two additional utilities, COPIER and TIMESET, then turns to a function (for the lack of a better name) that is a convenience to many programmers, and finally presents a set of guidelines for installing software packages on the MAX.

You will already, by the time you read this section, have used COPIER to create the backups to your Original System Diskettes. The description in this section will provide complete reference documentation to the COPIER program itself.

TIMESET is a utility that allows you to change the time on the standard MAX-80 clock/calendar. The time is set before the MAX is shipped, but you will still have to reset it for your own time zone. TIMESET is a very quick, and convenient, utility.

The third section describes a random number generator. Many programmers need a random "seed" for a program (they might, for instance, want to demonstrate that, even with an arbitrary starting point, you always get the same result). But there is no way to generate a random seed, except by one's own guesswork -- which is not very random. Lobo's Pseudo-Random Number Generator won't generate a truly random number, but it will generate one that is pretty close -- it certainly is a lot better than guesswork.

And, finally, this manual discusses a subject near and dear to no one's heart, software installation. To run most software on the MAX, you are going to have to tell the program about the MAX's characteristics. It's hard for a program to clear the video screen, when it doesn't know what commands are needed in the MAX-80. It's hard for a program to even write a simple message on the screen, when it doesn't know where the cursor is. The commands for these functions are different in every computer. So your software must know what the commands are in your computer, your MAX-80. This section describes all of the specialized MAX-80 commands, and gives advice on installing software on the MAX.

Technical Reference Manual

The technical documentation of the MAX-80 is split along the traditional line dividing the computer world -- hardware and software. The hardware section describes the requirements of all of the input/output ports on the MAX-80, and the Appendices (which are all hardware oriented) provide copies of the original manufacturers' documentation on all of the major chips in the MAX-80. (The other chips are standard items that are described in most modern logic design reference manuals.)

The System Programming section describes, in detail, all of the dedicated hardware addresses in the MAX. With this information, one could install a complete operating system on the computer (in fact, many have been already).

All That?

You do not have to read everything in this manual in order to be able to run the MAX-80. It is a large manual because we try to describe all of the important aspects of the MAX -- so that you have the least difficulty in using it. Your best approach, therefore, will be to pick and choose what you need from all of the manuals.

But first, the hardware setup. Everyone needs that.

MAX-80 OPERATION MANUAL

INTRODUCTION

LOBO SYSTEMS

INTRO-12

VERSION 2.1

# GLOSSARY

**APPLICATION PROGRAM:** Software which is written to accomplish a particular task, usually in the business environment. For instance, many companies use programs called "accounting packages". An accounting package is a set of application programs which together are capable of computerizing the accounts receivable, accounts payable, general ledger, payroll etc. of a business. Other applications are given by mail list programs, statistics programs, fortune teller programs, all the necessary software for running a small business. Now that you own a MAX-80, you can purchase and use application programs which are distributed in the Xerox 5-1/4 inch CP/M format or the standard CP/M single-sided, single density 8 inch diskette format. In addition, with the other operating systems available for the MAX, you will be able to use most of the applications programs which run on the TRS-80 Models I and III.

**BACK UP:** To make copies of. To back up a floppy diskette or a hard disk is to duplicate the contents of the disk. This is necessary because the information on the disk is readable only by your computer -- and only then if everything on the media is in order. If anything goes wrong with that copy, it will be next to impossible to get all of the rest of the information off that disk. And, of course, the time that you have only one copy of valuable information is the time that something will go wrong. Thus the absolute necessity of backups.

**BAUD:** One signal change per second (applied to serial communications devices). This term is usually taken to mean the same as "bits per second", but that is inaccurate. In slow speed serial communications, the baud rates (such as 300 baud) do coincide with the data rates given in bits per second. But in higher speed serial communications advanced techniques are used to transfer a number of bits of information in one signal change -- thus making the bits per second data rate many times that of the baud rate. Because every communication requires some extra bits to be included to doublecheck the accuracy of the transmission, a rate of 300 bits per second amounts to an actual transmission of 30 characters (letters, symbols, control codes) per second.

BELL 103, 202, 212, and many other numbers. The standards put forward for telephone transmission. In the microcomputer world, 103 is for modems that run only at 300 baud, 202 for modems that run only at 1200 baud, and 212 for modems that run at either 300 or 1200 baud. The 202 and 212 modems are considerably more expensive than the 103 modems, but the 103 modems are so slow that they cost quite a bit more in long distance phone bills and in aggravation (since many people can read faster than that). The 202 modems have largely been replaced the the 212 modems, since they're nearly the same price and the latter can communicate with a greater variety of other modems.

**BIOS:** Basic Input/Output System. The part of CP/M which is created by the hardware manufacturer for a particular configuration of hardware. Lobo Systems has created the BIOS for the MAX-80. This BIOS is located in special system files on your MAX-80 system disks; it is loaded into RAM each time your system is turned on or the RESET button is pushed. The program that Lobo wrote to create this BIOS (called its "source code") is also included on the CP/M System Diskettes. The availability of the source code allows a systems programmer to completely reconfigure the operating system to his or her own desires.

**BIT (Binary digiT):** A 0 or 1. The computer responds to 0's and 1's and combinations of 0's and 1's. It takes eight of these (called a "byte") to uniquely represent a character. If you never write computer programs, then your only involvement with bits is that you may want to get an idea how many words or pages of English you can fit into your MAX-80 or its disk drives. Check the definitions of Byte, Kilobyte, Megabyte and Permanent Storage Device.

**BOOT:** When the system is powered up or the reset button is pushed, the boot process is started. This begins with the execution (running) of the program that is contained in the boot ROM. This is a very small program (512 bytes, to be exact). It is only big enough to sound the speaker beep (warning you that your system is not really running yet) and to go out to a disk drive (whichever one is indicated by the boot drive selection switch on the back of the MAX) to get the operating system. No matter which operating system is being used, the boot diskette in the designated boot drive must be turned on and have an appropriate version of the operating system in place. These versions are constructed specifically to operate with the MAX-80. That is, the boot diskette must contain a special MAX-80 version of the operating system. If the appropriate data are found on the boot disk the speaker tone will cease, the system will successfully boot (start up) and the user prompt for the operating system being used will appear. The term "boot", by the way, comes from some jargon of yesteryear: "lifting oneself up by one's own bootstraps". Fortunately, starting up your MAX is a little easier than that.

**BOOT DRIVE SELECT SWITCH:** This switch is accessible from the rear of the MAX-80 and is used to designate the drive that the MAX-80 will expect to be the permanent boot drive. The switch settings are given in the Hardware Setup section of this manual.

**BOOT SECTOR:** The initial chunk of code which the boot ROM looks for (on the diskette or hard disk) and which is responsible for causing the rest of the operating system to be properly loaded into memory.

**BUG:** A problem in either hardware or software (though usually applied to software). At times it is debatable whether some occurrence is desirable or not -- which leads to the ancient saying "One person's bug is another person's feature" (Pliny the Elder, circa 50 AD). Odd happenings in software are universally regarded by software users to be bugs, but by software authors to be features.

**BYTE:** Eight bits. This is the smallest unit of information that can be used to represent a single character or microprocessor instruction.

**CAPS LOCK (SHIFT LOCK) KEY:** The key that puts all of the letters you type into upper case. In CP/M Plus the initial caps lock key is the "unshifted" F1 key, but you can change it to any other function key by using the program MAKESYS. The MAX-80 CP/M caps lock is a computer caps lock -- that is, it holds all the letters at uppercase, but the numbers and all other symbols remain at their unshifted values. (As opposed to the typical typewriter, which gives you all the symbols over the numbers when you have the shift lock on.) The program MAKESYS also allows you to specify that your computer start off each day in the caps lock mode. (F1 can then be used to delete the caps lock.) This is useful if you do a lot of BASIC programming, since BASIC only understands capital letters.

**CHARACTER MATRIX:** Each character that you see on your video screen is made up of discrete units of light (pixels). The MAX-80 can put 192 different symbols (all redefinable by the user) on the screen at one time. There are two types of characters that make up these symbols. 128 of the characters are each composed of a matrix that is 8 pixels wide and 8 pixels tall. 64 of the characters are made up of matrices that are 8 pixels wide and up to 16 pixels tall. To understand what "user-defineable characters" means, see the definition of Graphics Resolution below.

**COMMUNICATIONS:** The RS-232 serial and the Centronics-type parallel interface ports are often called communications ports because they usually are used to interface to communications devices, such as modems and printers.

**COMPATABILITY:** Two computer systems are compatible when they can run each other's programs. But to run each other's programs, they usually have to be able to read each other's diskettes. (We say "usually" here, because you can also get programs into your MAX through a modem attached to your phone line. In that case, you MAX might not even have the same diskette size as your host computer. Because your MAX-80 supports CP/M, you have compatibility with many other business computer systems. CP/M's most standard format is one that is single sided, single density, 8-inch, 77 track and soft-sectored. If you have a Lobo Systems 8 inch drive attached to your MAX-80, your MAX-80 is capable of reading this standard release format for CP/M. Your MAX-80 can then be said to be compatible with all other machines which support that format.



The 5-1/4 inch world is not as simple as the 8 inch world. There are too many 5-1/4 inch diskette formats for any one of them to be called a "standard". MAX-80 CP/M will both read and write the same format as is used by the Xerox Corporation 820 computer, one of the largest selling CP/M computers that uses 5-1/4 inch drives.

**CONTROLLER:** An electronic circuit board (or box containing an electronic circuit board) that governs some device. If a box plugged into the expansion bus connector of your MAX-80 turns your appliances on and off under certain conditions, then that box is a controller. A controller usually works in both directions: it takes commands from the computer, but it also feeds data back to the computer (so that the computer can make intelligent decisions based on the facts -- or, at least, based on the facts as the controller sees them).

**CP/M:** Control Program for Microcomputers. (The CP/M anagram originally stood for "Control Program/Monitor", which even fewer people understood.) CP/M was created in 1974 by Dr. Gary Kildall of Digital Research. This operating system is so popular in the microcomputer industry that it has become known as "a standard microcomputer operating system". Not all microcomputers are capable of supporting CP/M, but many do. The widespread use of CP/M has encouraged the development of impressive quantities of application software which run under CP/M. The MAX-80 is sold with Version 3 of Digital Research's CP/M and can support all correctly written applications which run under that version (as well as most of the programs that run under earlier versions) of CP/M.

**CRT:** A Cathode Ray Tube, also referred to as a video monitor or a video screen. The instructions or text which you input (type in) through the keyboard appear on the screen, as do the computer's responses to your instructions. When you boot up (turn the power switch on or push the RESET button when the power is already on) the MAX-80 begins executing its boot ROM instructions. You will see evidence of this because the computer will start to write messages on the CRT. (If the boot up is successful, it show you the system prompt for the operating system you are using.) When you ask the MAX-80 to run a particular program, what you see on the screen will be the results of the computer's following the instructions provided to it when that program is executed (run).

**CURSOR:** The shape on a video screen that shows where the next changes will be made. If you type a key, the appropriate character will show up at the location of the cursor, and the cursor will jump to the next appropriate location. Usually the next location is just to the right of the last one, or on the next line if you're at the end of the one you're on. This is just a result of Western tradition, the Western cultures typically writing from left to right and top to bottom. But there is no necessity for the cursor to follow tradition. In a database program the cursor can jump from location to location, depending on where the author wanted you to fill in the next blank. In a game the cursor usually jumps all over the place -- though usually all the wrong places are preferred.

**DATA:** Information. In computer systems this is either on disk, in RAM, in ROM, or en route between hardware components. Fundamentally, computer hardware knows no data but 1's and 0's, the on and off electrical states of its circuits. All of the information that you are interested in is only known to the computer by translation, by a program translating what you tell the computer into those 1's and 0's -- and back again when you want the answers to your problems. Thus you need both hardware and software to collect, analyze and disseminate data with a computer.

**DATABASE:** A structured collection of data that is kept on disk and which is accessible and updatable by applications programs. The database of a business is the primary factor in how much disk storage the business needs.

**DISKETTE:** The diskette is the medium used for data storage in floppy (flexible) disk drives. Most business microcomputers have at least one floppy disk drive, even if they also have fixed disk drives. Diskettes are convenient because, relative to other types of storage media, they are inexpensive and portable. Your operating system arrives on diskette, as does every applications program you will use. You will be purchasing blank diskettes both for data storage and for backups for the system and applications diskettes which you be purchasing.

The diskette is a circular piece of mylar that is coated with a magnetic film. It is permanently enclosed in a square, protective jacket. The diskette is inserted in a certain orientation into the disk drive and then is read by a special mechanism inside the disk drive. The diskette can contain operating system data, data that represent text, data that

represent runnable programs, and data that represent a company's data base. In a system which has only flexible disk drives the diskette is the only means of permanent (non-volatile) storage. In a system which has one or more fixed disk drives, the diskette is used to bring programs and data to and from other computers. Applications programs are almost always purchased on diskettes.

**DISK OPERATING SYSTEM (DOS):** The software which tells the computer how to make use of all of its hardware components, including disk drives. If the MAX is to successfully start up, this software must be present in on a diskette or hard disk of the chosen boot drive. The machine must be booted before any other software can be executed (run). Once the machine has been booted, the disk operating system has been loaded into memory (RAM) where it resides while the machine is on. Usually the system disk must reside in the boot drive during operation, even after boot up, because the parts of the operating system that are loaded into memory may require that other parts of the operating system be read from the boot disk.

**DISK SYSTEM:** Your MAX-80 is a disk system. It requires a disk drive for operation. It supports a number of popular disk operating systems -- CP/M, DOSPLUS, LDOS and MULTIDOS. The diskette or diskettes that contain the operating system are called the system diskettes. When the machine is booted, the operating system on the diskette in the boot drive is loaded into memory and run. The terms "disk system", "disk based system" and "RAM based system" are often contrasted to "ROM based system". In a ROM based system the operating system (and usually one or more programs, such as BASIC) is stored on a ROM inside the computer, so no disk drives are necessary to run the computer (though they are a practical necessity, anyway, for doing serious work). See DISK OPERATING SYSTEM and ROM.

**DOSPLUS:** TRS-80 compatible operating system that runs on the MAX-80. The MAX-80 version is closest to that of the Radio Shack Model 4 operating system, and runs most of the Model 4 software. DOSPLUS was created and installed on the MAX-80 by Micro-Systems Software, Inc. The complete DOSPLUS documentation is provided in a manual that comes with the operating system.

**EXPANSION:** Addition of peripherals to a computer through expansion interfaces such as the MAX-80 expansion bus port, disk drive connectors, or RS-232C serial ports.

**EXPANSION BUS:** A set of lines coming out of the MAX-80 which may be used for attaching specialized controllers, data acquisition devices, speech synthesizers, etc. Most computers that do have expansion capability are expandable only through a unique bus -- i.e., equipment that works on other computers must be adapted to work on this one. The MAX-80 is no exception, though the MAX-80 expansion bus was designed to be as close as possible to the Radio Shack Model I expansion bus (given the constraints of the other circuits in the MAX). Controllers designed for the Model I will usually have to be adapted, but that adaptation should be a lot easier than if you had to start from scratch. Why the Model I? We chose that bus because a very large number of inexpensive controllers are available for the Model I, and an even larger number of articles have been written describing how to build your own controllers for the Model I.

**FIXED DISK DRIVE:** A permanent storage device which has non-removable media capable of storing large quantities of data very reliably. The access time (the time taken to find specific data) for the fixed disk is very fast. High access speed, coupled with very large storage capacities, make fixed disks desirable for business systems. Businesses usually require that very large data bases be readily accessible to application programs.

**FIXED MEDIA:** The media in a fixed disk drive. Unlike the media in a flexible disk drive, these media are permanent. (They are usually solid aluminum platters coated with a magnetic material and held place so that they can rotate, but cannot be removed from the drive mechanism.) Since they are capable of storing far more information than a floppy diskette, the fact that the media are permanent is not a problem. Floppy disk drives are also desirable in a system which has a fixed disk drive because the flexible media can be used either to transfer information to other computers or to back up (make duplicates of the information on) the fixed disk drive.

**FLEXIBLE OR FLOPPY DISK DRIVE:** The device which reads and writes on flexible or "floppy" media. (See Diskette.)

**FORMAT:** The pattern for recording data on the storage media. The type of drive containing the media and the disk operating system being used determine the format of the media. In order for a diskette to be read under a particular operating system on

**LDOS:** TRS-80 compatible operating system that runs on the MAX-80. The MAX-80 version is closest to those of the Radio Shack Model I and III operating systems, and runs most of the Model I and III software. LDOS was written and installed on the MAX-80 by Logical Systems, Inc. The complete LDOS documentation is provided in a manual that comes with the operating system.

**LOGIC BOARD:** Printed circuit board which houses a microprocessor, video controller, communications, and memory chips and their associated circuitry. The MAX-80 contains two logic boards which are described in detail in the MAX-80 Technical Reference Manual.

**MEGABYTE (MB):** 1,048,576 bytes. There are 1024 Kilobytes in a Megabyte.

**MICROPROCESSOR:** See Processor.

**MEGAHERTZ (MHz):** One million cycles per second. The Z80B in the MAX-80 processes at 5 MHz or 5 million cycles per second.

**MODEM:** Short for MODulator DEModulator. A device that connects the MAX to a telephone line so that messages, files, etc. can be sent or received over the telephone network. For various types of modems, see the definition of Bell, above.

**MULTIDOS:** TRS-80 compatible operating system that runs on the MAX-80. The MAX-80 version is closest to those of the Radio Shack Model I and III operating systems, and runs most of the Model I and III software. MULTIDOS was written and installed on the MAX-80 by Cosmopolitan Electronics Corporation. The complete MULTIDOS documentation is provided in a manual that comes with the operating system.

**ON LINE:** "Accessible to the computer." You could say that there are 3 disk drives on line, or that there are 5 MB of storage on line.

**OPERATING SYSTEM:** See Disk Operating System, CP/M, DOSPLUS, LDOS and MULTIDOS.

**PARALLEL PORT:** The parallel port is the communications port used to interface to parallel (Centronics-type) printers.

**PC BOARD (PRINTED CIRCUIT):** See Logic Board.

**PERIPHERALS:** Any hardware device which is interfaced to a computer -- such as fixed and flexible disk drives, printers, modems, CRTs, voice synthesizers, and plotters.

**PIXEL:** A single cell on a screen. See Graphics Resolution.

**PORT:** An Outlet for a cable that connects one or more peripheral devices to the MAX-80. The MAX-80 has 8 ports (not counting the power cord inlet) -- for up to four 8 inch floppy drives, up to four 3-1/2 inch or 5-1/4 inch floppy drives, a SASI Winchester drive, a Centronics-compatible printer, one or two RS-232C serial devices (two ports), another expansion device (controller, electronics project board, etc.), and the CRT. Most of the ports require edge connectors, 34 pin for the 3 and 5 inch drives and for the parallel printer, 40 pin for the expansion bus, and 50 pin for the 8 inch and Winchester drives. The RS-232C connectors each require a DB25 (25 pin) connector, and the video requires a "phono" plug. The technical details of all of these ports are given in the Hardware Part of the Technical Reference Manual.

**PROCESSOR:** The device located in a computer which performs calculations and controls the flow of data to and from the different components of the system. The MAX-80 has a Z80B processor. The speed with which the computer can schedule and carry out its activities depends on the speed of the processor as well as the speed with which it can send data across communications lines.

**RAM:** Random Access Memory. A RAM chip provides volatile (non permanent -- i.e., when the computer is turned off, the information is gone) memory capability. The MAX-80 has 16 64 kilo-bit RAM chips which together provide 128K byte RAM. In order to function correctly, the processor needs to know where in RAM to look for a specific type of information. Therefore RAM

a particular computer, it must be in a format which is readable to that system. One advantage to all of the MAX-80 operating systems is that floppies can be formatted and written by a non-MAX-80 computer and then can be read and written in the MAX-80. For example, single-sided, single-density 8-inch, flexible, soft-sectored diskettes which are formatted under the CP/M operating system on another computer system are compatible with a MAX-80 which has a Lobo Systems 8 inch floppy disk system attached.

**FUNCTION KEY:** A keyboard key that may be used for various functions -- such as commands for the operating system, typing out a full string of letters at a single keystroke, slowing down the screen display, etc. MAX-80 CP/M Plus actually provides for 12 function keys: keys F1 through F4, CTRL-F1 through CTRL-F4, and SHIFT-F1 through SHIFT-F4, each of which can have a unique function.

**GRAPHICS RESOLUTION:** The number of points of light (pixels) that can be seen on the screen, and the way in which these pixels are controlled in order to create shapes. The MAX-80 has the capability of displaying 640 pixels horizontally and 225 pixels vertically and allows a great degree of control over the images you can create on your screen. There are 192 character shapes which the MAX-80 is capable of displaying at one time. You may re-define any or all of these character shapes. Although you can not independently control each dot (pixel) of light (a method of graphics resolution control known as bit-mapping) you can achieve the following results:

You can change characters to accommodate the needs of foreign language alphabets.

You can create a small, truly bit-mapped area of adjacent characters, as long as this area is no larger than 192 character positions. This is done by providing a different character shape for each character position in the area.

You can design a special set of character shapes which, when placed in adjacent character areas, can be used to draw larger but simpler diagrams, than those that are represented by bit-mapped graphics. We call these "simpler" diagrams because in order to cover the entire screen area it is necessary to repeat some characters many times. This capability allows creation of graphics shapes such as bar charts and block diagrams, which are often useful in the business environment.



The creative system programmer can achieve very effective display images with the MAX-80's redefineable characters. The Technical Reference Manual provides the technical details about this feature.

**HARD DISK:** See Fixed Disk.

**HARDWARE:** All components of the MAX-80 except the documentation, storage media and the contents of the storage media. The first part of this manual tells how to set up your MAX-80 hardware.

**HEADER:** A device for connecting two sets of lines. One of the primary causes of trouble with serial devices is that they put their signal lines in different places. These devices are almost always compatible with the MAX-80. But they almost always have their lines in different places than the MAX expects. There are three ways of connecting the correct lines together: changing the lines in the peripheral device (rarely feasible), changing the locations of the lines at either end of the cable (possible, but sometimes expensive and troublesome -- because the easiest cable to use is the molded one that already has all its lines in place), and changing the lines in the MAX-80. The last method has been made quite easy, because the MAX-80 includes two removable headers (one for each serial port) whose lines may be moved with a minimum of effort. See the description in the Hardware Part of the Technical Reference Manual.

**INTERFACE:** In the computer industry the word "interface" is used to refer to hundreds of different types of instances in which two pieces of equipment must be able to work together or to send data to one another. This term is often used to refer to the software needed to make a particular computer system perform a particular function. And is more often used by people who like to throw computer jargon around. In this manual we will try to minimize our use of this term. However, when we do use it, we are talking about the connector or port which accepts the cable from a peripheral.

**KEYBOARD:** The top surface of the basic MAX-80 unit contains the key pads on which the user types.

**KILOBYTE:** 1024 bytes. There are 1024 kilobytes in one Meagabyte. The capital K indicates the number 1024; the small k indicates good old 1000.



is divided into separate locations, each with its own address. When we speak of 128K of RAM, we mean that there are 128 Kilobytes of volatile memory (or 131,072 different addresses which the processor can keep track of. The 280 processor chip is only capable of keeping track of 64K (65,536) different addresses at one time. This means that the 128K RAM in the MAX-80 is twice as much as the processor can keep track of at one time. In order for the extra 64K of RAM to be useful, a method for trading portions of RAM in and out of 280 address range was designed. The operating system being run must know how to tell the processor which area of RAM to activate so that a particular location of memory can be accessed. Also see ROM.

**RASTER-SCAN LINE:** One of the lines which run horizontally across the CRT screen and which contains the pixels which are used to form shapes. There are eight raster-scan lines in an alphabetic character that is represented on the MAX-80 CRT.

**RIBBON CABLE:** A type of cable used to connect peripherals to the computer. Your disk system must connect to the appropriate disk system interface via the appropriate ribbon cable.

**ROM:** Read Only Memory. When a program is installed in it, the ROM is also called Firmware. ROMs are chips which contain programs that are executed by a computer. Usually the ROMs are activated upon boot up of the system and their code is placed into an area of memory. For instance, the MAX-80 contains a boot ROM with code that executes every time the MAX-80 is powered up or the reset button is pressed. This code is placed into a particular area of memory. It tells the MAX-80 to look for the disk operating system on the boot disk, and to load it into another location (address) in memory. Some computers have ROMs with BASIC in them. Children's toys have ROMs which are capable of activating voice synthesizers and video displays. The MAX-80 does not have a high level language in ROM. The MAX-80 ROM has been kept very simple (it only serves boot functions) so that the usefulness of the computer can be maximized. If the MAX-80 did have BASIC in ROM, the BASIC would be occupying a particular area of memory every time the system is turned on. This would limit the MAX-80's ability to use different disk operating systems that might require that the same area of memory be used for a different purpose. The MAX-80 depends on disk storage devices rather than ROM's to provide it with executable code. That code all runs from the 128K RAM in the computer. For that reason, the MAX-80 is what is termed a "RAM based system". Also see RAM.

**RS-232C:** A type of serial communications port commonly used to interface to printers, plotters, modems and mainframe computers. The MAX-80 contains two RS-232C ports.

**SERIAL PORT:** See RS-232C.

**SOFTWARE:** Programs which the computer can execute (load into memory and run). Programmers write series of instructions in high or low level languages. High level languages include C, BASIC, COBOL and other applications programming languages which must be interpreted or compiled before they can be executed (run as programs). Low level languages are those which consist of instructions which have a one to one relationship with instructions that the machine's processor can understand. Disk operating systems are software, and so are applications programs.

**SPREADSHEET:** A type of program used for doing multiple interconnected calculations. These programs were created in order to replace the accounting worksheets that contain many rows and columns of calculations, but today have much wider uses (engineering and scientific calculations, modeling in production management, etc.). They are also called Calcs, Calcsheets, Financial Modelers, etc.

**SPEECH SYNTHESIZER:** A device for turning computer signals (from either a parallel or serial port) into noise. Sometimes the noise even sounds like something recognizable. But never believe a fast talking computer. This device is the opposite of the **SPEECH ANALYZER**, which converts noise into computer signals. If you don't believe what the computer tells you, what do you think the computer believes about what you're telling it?

**UTILITY:** A program that accomplishes a particular narrow task, usually a task associated with the operating system or the MAX-80 itself. Thus the program **TIMESSET** is a utility, because it allows you to easily set the clock/calender. The same is true of **MAKESYS**, which allows you to set the operating system up for various disk drives, printers, and modems, as well as changing the MAX-80 for your own proclivities (keyboard layout, function keys, even the cursor shape).

**WINCHESTER DISK DRIVE:** A specific type of hard disk drive invented by the little known IBM Corporation. The first versions of the drive had two plates (disks), each with 30 MBytes of storage (and were physically quite a bit larger than the drives we today know as Winchester), and were called 30-30s. But soon the name changed to Winchesters. So if you run into anyone who says they used to know Mr. Winchester himself, you now know that you would be better off to get computer advice elsewhere.

**WORD:** Inside the computer: two bytes (16 bits) in succession. In the MAX-80's Z-80B microprocessor, each address is given by a Word. The term is still used in the normal way when it comes to human words.

**WORD PROCESSOR:** A program for writing, editing, rewriting, and deleting the whole mess. Since the primary reason for computers is communication, word processors are by far the most popular programs purchased for computers, especially for microcomputers.

**Z-80B:** A microprocessor designed and produced by the Zilog Corporation. The Z-80B is a very fast (maximum clock speed is 6 Megahertz -- 6 million cycles per second) member of Zilog's Z-80 family of microprocessors. Slower members of the family can be found in other CP/M and TRS-80 compatible microcomputers.

MAX-80 OPERATION MANUAL

GLOSSARY

LOBO SYSTEMS

INTRO-28

VERSION 2.1