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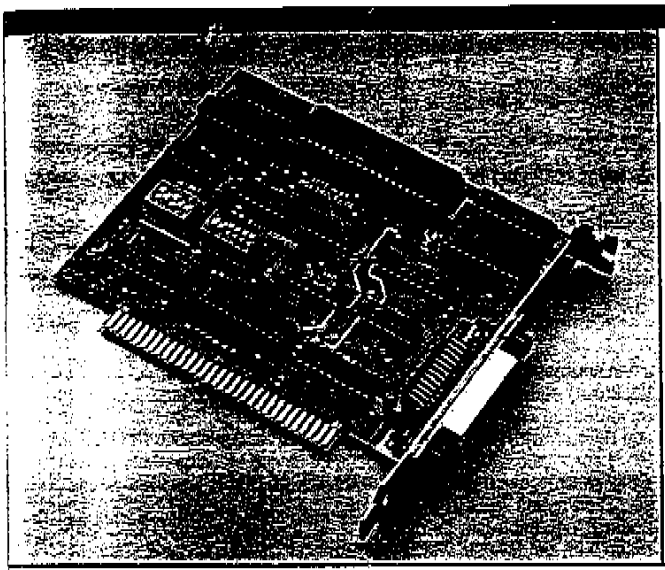
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Corporation

IEEE – 488 INTERFACE MODEL MBC-488

DATA ACQUISITION AND CONTROL FOR IBM PC/XT/AT AND COMPATIBLE COMPUTERS



FEATURES

- SOFTWARE INCLUDED ON DISK
- New DOS resident Software makes reading and writing to the board as easy as reading or writing to a file.
- Plugs directly into IBM PC/XT/AT
- Interrupt, DMA and Normal transfer modes
- Fully compatible with IEEE-488 1978 Spec.
- Transfer Full String, Word/Byte, or Integer value
- Supports up to 15 Devices Simultaneously
- New LPT1: driver allows printer or plotter outputs to be automatically transmitted to a GPIB device.

APPLICATIONS

- Laboratory Automation
- Automated Manufacturing testing
- Interface with Plotters/Printers
- Instrument Interfaces

FUNCTIONAL DESCRIPTION

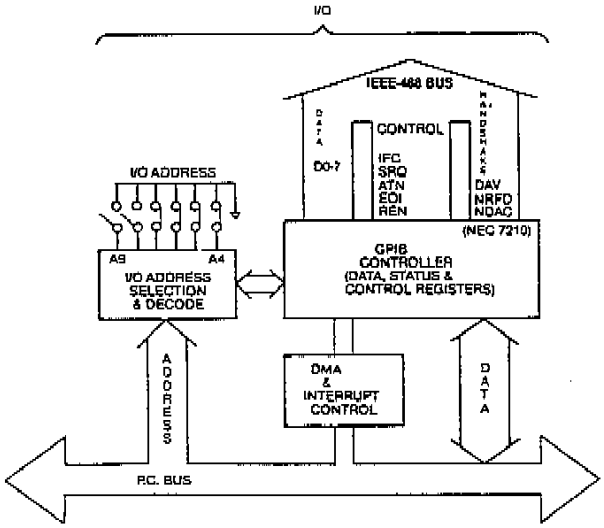
MetraByte's MBC-488 GPIB/IEEE-488 interface board plugs directly into any I/O expansion slot of an IBM PC/XT/AT, PS/2 Model 25 or 30, or compatible computer. A standard GPIB connector extends out the rear of the computer and connects to any standard IEEE-488/GPIB cable.

A complete software driver interface is included on the MBC-488 disk. The driver is DOS resident, and is loaded into the computer's operating system each time the computer is turned on. The DOS resident driver is extremely easy to access, and is written to, or read from by using the same simple commands that are used to read or write to a disk file, (e.g. in Basica, Print commands for writes, input commands for reads). The File I/O type of driver eliminates the need for initializing and calling complex assembler subroutines.[1]. Since the device driver is interfaced just as a file would be, the driver is easy to use from any upper level language (e.g. Basic, Fortran, Turbo-Pascal, etc).

The MBC-488 will allow up to 14 other Talker/Listener devices. In addition, the software driver will support 1 or 2 MBC-488 boards at a time. The controller may be the PC or any of the other devices on the bus. The board is based on the industry standard NEC 7210 IEEE-488 interface chip and offers 100% compliance with the 1978 IEEE-488 interface standard. The use of the 7210 also assures compatibility with almost all third party software packages (e.g. ASYST, ASYSTANT GPIB).

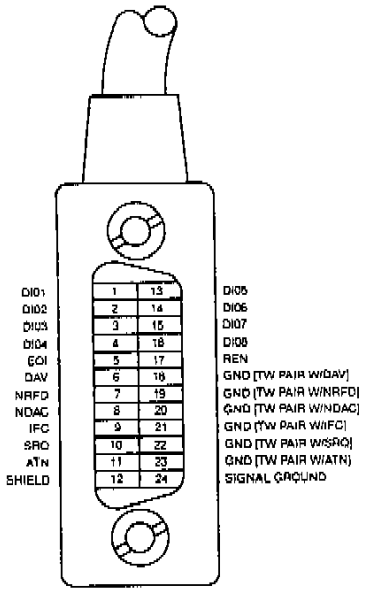
1. Note for users of the MBC-488 prior to the release of this new driver: The original call routine software is unchanged, and is still included on the MBC-488. There is no need to re-write any existing software to continue using MBC-488s. In addition, for new applications, though the new device driver provides a new, simpler to use programming interface, the command strings of the new driver are virtually identical to the old one. No new commands or abbreviations need be used.

BLOCK DIAGRAM



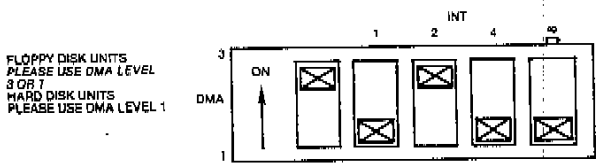
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GPIB PIN CONNECTIONS



INTERRUPT VECTORS/DMA CHANNEL SELECTION

The following drawing illustrates interrupt level 5 and DMA channel 3 selected.

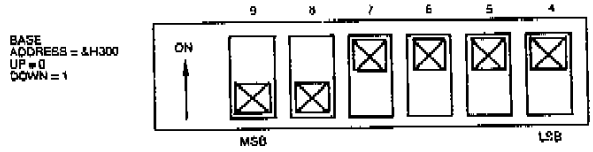


* If DMA operation is not required the MBC-488 can be installed in the short J8 (expansion) slot of the IBM PC/XT by switching the J8 switch on. If used in any other slot or a slot in a standard IBM PC/AT or compatible the J8 switch should be set in the OFF position.

BASE ADDRESS SWITCH

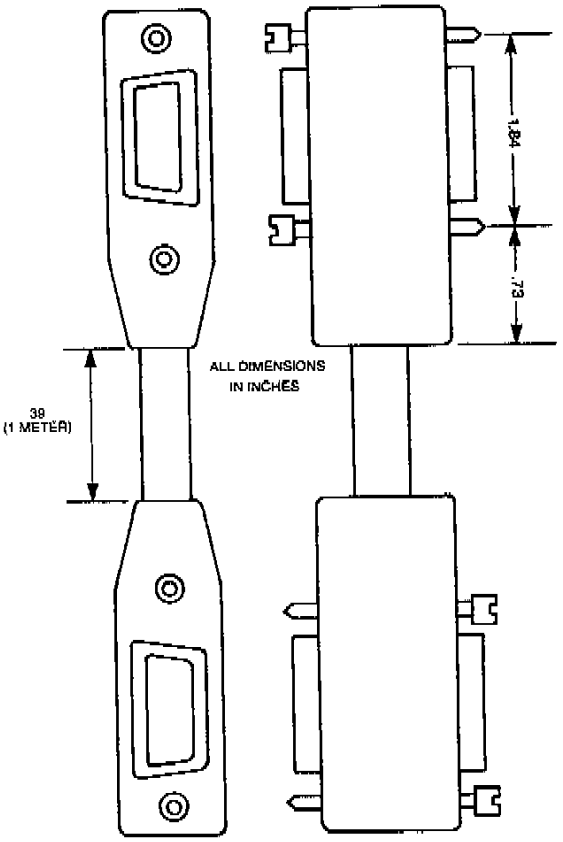
The IE488 board requires one slot in the IBM-PC and 16 consecutive address locations in I/O space. Some I/O address locations will be occupied by internal I/O and your other peripheral cards, so to provide flexibility in avoiding conflict with these devices the IE488 I/O address can be set by the Base Address D.I.P. switch to be on any 16 bit boundary in the IBM-PC decoded I/O space. This also makes possible the use of a second IE488 interface board in the same computer. The user may transfer data to or from the two groups (device to device). This allows the user to have two controllers on line, one for each group. Now data can be transferred among 30 different devices. The I/O map for IBM's standard Internal/External peripherals is listed on page 2-23 of the "IBM Technical Reference Manual".

The Base Address switch is located on the top left corner of the board.



CGPIP-01 GPIB CONNECTOR CABLE

A drawing of MetraByte's CGPIB-01 Adapter cable is shown below. The cable has a standard length of 1 meter (approx. 3 feet). Two and four meter lengths are available.



CGPIB-01 ..... ***$ 75.00***
CGPIB-02 ..... ***$ 96.00***
CGPIB-04 ..... ***$138.00***

SPECIFICATIONS

Number of Devices Serviced	15
Maximum Number of MBC-488 cards in PC	2
Mating Cable required	CGPIB-01
Total Bus length	20 meters (not exceeding 2x the number of Instruments)
Data Transfer Rate	2Kbyte/Sec
DMA Data Transfer Rate	450Kbyte/Sec
Max. Number of Talkers at one time	1
Max. Number of listeners at one time	15
Power Consumption at +5V	470mA Typ. 600mA Max.
ENVIRONMENTAL	
Operating Temperature Range	0 to 50 Deg. C.
Storage Temperature Range	−40 to +100 Deg. C.
Humidity	0 to 90% Non-Condensing
Net weight	4.25 oz. (0.125 Kg)

THE PRICE
MBC-488 Including Software ***$275.00***

MetraByte

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MBC-488 DEVICE DRIVER COMMANDS (CONT.)

REMOTE
Sets the selected device(s) to remote position. If no devices are specified, the REM line in asserted. The IBM must be the active controller or an error will occur.

COMMAND FORMAT:

"REMOTE [dev1,dev2,.....devN]"

REQUEST
The GPIB may request service from the active controller on the bus by executing the "REQUEST 1" command.

This command has two modes. The first when "1" is omitted which may be executed any time to monitor the status of the MBC-488 interface board. The VAR% INTEGER contains the status bits for the GPIB board addressed.

The second mode when "1" is specified, is used when not in control allows the user to set a serial poll status word to the controller in charge. The Low byte of the variable will contain the STATUS byte to be transferred to the controller.

COMMAND FORMAT:

"REQUEST[1]"

RXCTL
Receive control of the bus. The VAR% (integer) is set true if the IBM regains control of the bus else VAR% is false.

COMMAND FORMAT:

"RXCTL"

STATUS
A serial polled devices status byte is read into the selected variable. The variable% will contain the Status byte of the device specified as a serial poll. The IBM-PC must be the active controller or an error will occur. Only one device is allowed with one secondary address. If no device is specified an error will occur.

COMMAND FORMAT:

"STATUS dev.secad"

SYSCON
SYStem CONfiguration and initialization of the GPIB, and software driver. This initializing command must be run once at the begining of the program preceding any other commands after power up. It should be included in the initializing code of any program. If SYSCON is omitted, an error code will be generated when attempting to run any other command. SYSCON provides the physical I/O location of the MBC-488 to the driver, sets up the operation of 1 or 2 boards as controllers or talker/listeners and specifies their talk/listen address. It also checks for invalid bus or controller states, and conflicting switch settings when 2 boards are in use (same base address, DMA level, interrupt level etc.) Base address data is entered in HEX.

COMMAND FORMAT:

"SYSCON MAD1=dev (MAD2=dev) CIC1=0/1/2 (CIC2=0/1/2) BA1=&Hdddd (BA2=&Hdddd)"

TIMEOUT
Sets the time out duration that the controller will wait for response when transfering data to/from the devices. The Variable integer VAR% is set to a number from 0000 to 65000. The timeout delay is VAR% * 0.056 seconds. No error is returned. The default timeout value is about 2 seconds.

COMMAND FORMAT:

"TIMEOUT", VAR%

TRIGGER
Sends a trigger message to the selected device or a group of devices. The IBM-PC must be the active controller or an error will occur. TRIGGER performs the Group-Execute-Trigger (GET) function useful for singly or simultaneously triggering measurements.

COMMAND FORMAT:

"TRIGGER dev1, dev2,..... devN"

UNT
Sends the GPIB UNT (un-talk) message, which will disable any addressed device's talker function. This command would be typically used after an ENTER command when the user doesn't expect continuous transfer of data from that device.

COMMAND FORMAT:

"UNT"

EXAMPLE PROGRAM

```
100 '*******************************************
110 '*
120 '*          IEEE488 Serial Poll Example Program
            (DVSPOLL.BAS).*
130 '*
140 '*      MetraByte Corporation              11-17-88
150 '*
160 '*******************************************
170 '
180 CLS:KEY OFF:LOCATE 25,1:PRINT"Press any key to exit pro-
    gram";:LOCATE 1,1
190 '
200 'This is an example of reading data from device 12, in this case
210 'a Keithley 196 System DMM.
220 'To run with a different device number, change command strings in
230 'lines refering to DEVICE 12.
240 '
250 'NOTE—This must be an ASCII file to function in Quick Basic
260 '
270 '##### Establish communication with device driver #####
280 '
290 OPEN "$DV488" FOR OUTPUT AS #1
300 OPEN "$DV488" FOR INPUT AS #2
310 ON ERROR GOTO 790
320 '
330 '##### Initialize MBC-488 board using "SYSCON"
    command #####
340 '
350 PRINT #1, "SYSCON MAD1=3 CIC1=1 BA1=&H300"
360 '
370 '##### Set DVM into REMOTE #####
380 '
390 PRINT #1, "REMOTE 12"
400 '
410 '##### Set TIMEOUT (timeout time=0.056 x A%) #####
420 '
430 A% =35
440 PRINT #1,"TIMEOUT",A%
450 '
460 '##### SET MODE TO TRIGGER ON "GET" #####
470 '
480 MODE$ = "T3F1M8X":CMD$="EOI 12[$]"
490 PRINT #1,"OUTPUT 12 $",MODE$
500 '
510 FOR I=1 TO 500:NEXT I 'wait for set-up st finish
520 '
530 '##### Send trigger message #####
540 '
550 PRINT #1,"TRIGGER 12"
560 '
570 '##### Wait for SRQ #####
580 '
590 PRINT #1,"REQUEST"
600 INPUT #2,REQ%
610 IF (REQ% AND &H4000) < > &H4000 THEN 590
620 '
630 '##### Read Serial Poll byte #####
640 '
650 PRINT #1,"STATUS 12"
660 INPUT #2,SPOLL%
670 IF (SPOLL% AND 8) < > 8 THEN PRINT "SR=";MODE$:STOP
680 '
690 '##### Read data from DVM #####
700 '
710 DVMDT$ = SPACE$(25) 'create blank string to receive data
720 PRINT #1,"ENTER 12 $"
730 INPUT #2,DVMDT$
740 PRINT DVMDT$
750 FOR I=1 TO 1000:NEXT I 'display period
760 KX$=INKEY$: IF KX$="" THEN GOTO 550
770 CLOSE
780 STOP
790 INPUT #2,ERROR$
800 PRINT ERROR$
810 END
```


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SOFTWARE

All commands are passed back and forth between your program and the MBC-488 device driver in the form of simple ASCII strings. A standard File-write command is used to send commands to devices on the Bus. For example, a typical BASIC output command would be.

```
380 '
390 PRINT #1, "REMOTE 12"
400 '
```

Where line 390 simply puts the GPIB device at address 12 into remote mode. Though other languages may not use the "PRINT #" command, all useful upper level languages will have an equally simple file output command.

COMMAND general syntax

The standard command string used will be in the form shown below:

[BRDN] COMMAND DEV IMAGE

where BRDN selects which MBC-488 is being accessed (BRD1 or BRD2). The BRDN variable is assumed to be BRD1 unless BRD2 is specified. COMMAND stands for the actual command to perform (e.g. Remote, Output, Enter). DEV selects the DEVice to talk to (0-31), and IMAGE allows the programmer to match the data transfer type, and termination sequence to any of the wide variety of different instruments available.

For example, in the command:

PRINT #1,"OUTPUT 12 $ # 0 128"

OUTPUT selects the output command type. 12 is the Device # to send data to. $ signifies that it will be ASCII String data. # tells the driver to activate the EOI signal. 0 128 says to start at position 0, and end at position 128.

Data and integers plus simple English error messages are returned via an input statement as shown below.

```
PRINT #1,"ENTER 12 $"
INPUT #2,DATA$
PRINT DATA$
```

MBC-488 DEVICE DRIVER COMMAND SET

ABORT

The command executes an IFC (interface clear) and DMA and Interrupts are disabled if activated. The IBM PC must be the active controller before execution or an error message will be generated. No device number is necessary.

COMMAND FORMAT:

"ABORT"

CLEAR

Clear or Reset device dependent functions within any selected device(s) or all devices. If no device number is given the whole GPIB is cleared. The IBM PC must be the active controller before execution or an error message will be generated.

COMMAND FORMAT:

"CLEAR dev1,dev2,.....devN"

ENTER

Reads data from a specified device on the GPIB into a string or integer array. Prior to ENTER, the array must have been correctly declared and dimensioned. If the IBM-PC is not the controller, it must have been previously programmed as a listener by the bus controller. If this is not the case, then the ENTER command will return the message "Not addressed" inform the caller that the IBM is not in the listen mode. The command may be re-entered until the controller in charge programs the IBM to listen. Only one device may be addressed to talk at a time with this command. In the Listen Only Mode, the card will enter any data on the bus until terminator is sensed or timed-out.

COMMAND FORMAT:

"ENTER dev.secad IMAGE", data

EOI

Sends the last word of a dma transfer with EOI asserted. EOI is the GPIB End or Identify control line that is used to assert the end of messages. The REQUEST command is used to detect the end of dma.

COMMAND FORMAT:

"EOI", LAST%

LOCAL

Set selected device(s) to the local state. If no device is specified then all devices on the bus are set to local. The IBM-PC must be the active controller or an error message will be generated.

COMMAND FORMAT:

"LOCAL [dev1,dev2,.....devN]"

LOCKOUT

Sets all devices on bus to the LWLS (Local With Lock Out) state. The REM line is asserted and the LLO message is sent. Any device already in remote, will go to RWLS state. If devices are specified, then their listen addresses are sent which places them in the RWLS (Remote With Lock Out) state where all front panel controls are disabled. LLO is an unaddressed command, the devices are allowed as a convenience to add devices without an extra REMOTE command. Sending the LOCAL DevN command, will return the specified device to LWLS state so front panel controls can be changed, but the LOCAL BUTTON is still disabled, so if addressed to listen, the device will return to RWLS state. The Lockout condition can be defeated only by sending the LOCAL command with no devices, which will return all devices to local state.

COMMAND FORMAT:

"LOCKOUT [dev1,dev2,.....devN]"

OUTPUT

Output selected string/integer data to selected listener(s) on the GPIB. The referenced variable will contain the data to be transferred. The image specifier controls the data variable type and terminator. Up to 14 devices may be accessed in the list. If the IBM-PC is not the controller in charge, the IBM-PC must be programmed to talk by the controller in charge before data can be transferred. In the TALK ONLY MODE, data will be output until a terminator is sensed or timed-out.

COMMAND FORMAT:

"OUTPUT [dev1.secad,dev2...] IMAGE", data

PARPOL

Reads the 8 Status Bit messages for the devices on the GPIB which have been set for parallel poll configuration. The VAR$ (string) will contain the 8 bit message. The IBM-PC must be the active controller or an error will occur.

COMMAND FORMAT:

"PARPOL"

PASCTL

The Active control of the GPIB is transferred to the specified device address and the IBM-PC becomes a standard listener/talker and ceases to be controller. The IBM-PC must initially be the active controller or an error will be returned. The IBM-PC is not allowed to Talk until programmed by the controller in charge.

COMMAND FORMAT:

"PASCTL dev"

PPCONF

Sets up the desired parallel poll bus configuration for the user. The VAR$ (string) contains the poll sequence (00-FF hex). The IBM-PC must be the active controller or an error will occur.

COMMAND FORMAT:

"PPCONF dev.secad", VAR%

PPUNCF

Resets the parallel poll type configuration of the selected device. The specified device(s) will not respond to a parallel poll command. If no devices are specified the PPU message is sent to un-configure all devices. The IBM-PC must be the active controller or an error will occur.

COMMAND FORMAT:

"PPUNCF [dev1,dev2,.....]"

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2.0 INSTALLATION

MBC-488 & the IBM PC/XT/AT

MetraByte's MBC-488 board uses 16 consecutive address locations in the IBM PC's I/O address space. Some I/O address locations will be occupied by internal I/O and other peripheral cards. The base address of the MBC-488 can be set by the Base Address DIP switch to any 16-bit boundary. This address space extends from decimal 256-1023 (Hex 100-3FF). The table below summarizes the usual address assignments and is reproduced from the "IBM Technical Reference Manual":

ADDRESS (Hex)	DEVICE	ADDRESS (hex)	DEVICE
000-0FF	Internal system	378-37F	LPT1:
200-20F	Game	380-38C	SDLC comm.
210-217	Expansion unit	380-389	Binary comm. 2
220-24F	Reserved	3A0-3A9	Binary comm. 1
278-27F	Reserved	3B0-3BF	Mono dsp/LPT1:
2F0-2F7	LPT2:	3C0-3CF	Reserved
2F8-2FF	COM2:	3D0-3DF	Color graphics
300-31F	Prototype card	3E0-3E7	Reserved
320-32	Hard disk	3F0-3F7	Floppy disk
3F8-3F	COM1:		

This list covers the standard I/O options. You may, however, have other peripherals e.g. hard disk drives, graphics boards, etc. that use I/O address space. Check the manuals that came with your other peripherals to avoid address conflicts. Review the above list and choose an address space 16-bits wide and set it via the Base Address DIP switch. The DV488 device driver (supplied) supports 2 MBC-488 boards. If you are using more than one MBC-488 board, separate Base Addresses are required to avoid address conflicts.

A second DIP switch (marked DMA/INT) is to the left of the Base Address switch and controls selection of DMA level, interrupts and operation in the J8 short slot of an IBM PC/XT. The first slider selects the DMA level. There are 4 DMA levels provided by the internal (PC) 8237 DMA controller. Level 0 is used internally by the system for memory refresh and is not available. Levels 1, 2 and 3 are available, with level 2 usually being used by the floppy disk drive. Level 1 is usually available, and level 3 is available on standard IBM PC (without hard disk) or IBM PC/AT. On the XT model, level 3 is used by the hard disk. Select the DMA level desired and set the switch accordingly. The MBC-488 can be operated in non-DMA modes in the rightmost short slot (J8) of a PC/XT by setting switch J8 ON (otherwise it should be OFF). This slot is normally intended for driving the expansion chassis interface and has slightly different signals from the other slots. If the DMA mode of operation is disabled, both DMA and interrupts will be disabled and their settings will be meaningless.

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There are 6 interrupt levels on the bus (2 thru 7). Interrupts are used for Direct Memory Access (DMA) data transfer only. With the exception of level 6 which is used by the floppy disk adapter, most of the other levels may be available. The MBC-488 is shipped with its DIP switches set for a base I/O address of Hex 300, interrupt level 5, DMA level 1, and the J8 slot feature disabled. These are usually good default values, and you may not need to alter them. If you want to check them or change them before you install the board in your computer, insert the software disk in your floppy drive and enter:

A> INSTALL

The INSTALL.EXE program is a self-explanatory program (INSTALL.EXE) that gives you a pictorial view the correct switch settings on the MBC-488 for any combination of addresses, interrupt level, DMA level etc. Simply set the switches the way you see them on the screen and press <ESC> to exit to DOS. You will also see warning messages for possible conflicting addresses. If you receive a warning for a device that is not in your computer, it can safely be ignored. These cautions apply strictly for IBM standard devices (although the same mapping is followed by most compatibles) and may not be totally foolproof as far as non-IBM peripherals are concerned. If your MBC-488 does not appear to work correctly, or interferes in some way with other devices on your computer e.g. disk drives etc. or your computer will not boot up, remove the MBC-488 and try a different I/O address, interrupt or DMA level. Once you have set the base I/O address, make a note of its value as you will need to use it in the SYSCON initializing command in your programs. All the other switch settings are read by the driver (software) so you can forget the interrupt and DMA level settings. Prior to installing the MBC-488 in your computer, SHUT OFF THE POWER and discharge any static electricity that you may be carrying. The MBC-488 will fit in any of the regular full depth slots of the IBM PC/XT/AT or the "half" slots of the IBM XT or Portable computer. You may feel some resistance when pushing the IEEE-488 connector through the rear panel of your computer as the slots are close to a clearance fit for this type of connector. The base of the connector plate has been machined with a slight undercut, so once seated in the slot it should slide up and down freely. When you mate a standard IEEE-488 cable to the connector, you may find it blocks adjacent slot access to some extent due to its width. This can be avoided by placing the MBC-488 in an end slot, or adjacent to a board that has no connector on it. If the connector becomes a problem, MetraByte's IE-488 board avoids this difficulty through the use of a special adapter cable. If you later remove the MBC-488 board, MetraByte recommends that you retain the special electrostatically shielded packaging and use it for storage.

Backing up the DV488 Diskette

It is important to make a back-up copy of the software supplied with MBC-488. The software is not copy protected so you may make as many copies as desired. It is supplied on a DOS 2.1 and higher double sided (360K) floppy disk format.

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3.0 DEVICE DRIVER (DV488)

Introduction and General Overview

DV488 is the overall name given to MetraByte's (uC)MBC-488 device driver and example routine software package. It is supplied free with the purchase of either the MBC-488 or the uCMBC-488 GPIB interface boards. The software contains many example programs. The examples illustrate serial and parallel data transfer in various formats including HIGH, LOW, PACKED byte, and STRING data. Additionally, single/dual board configurations, (uC)MBC-488 usage as talker/listener, and DMA/programmed data transfer modes are shown. The examples are done in BASICA, C, FORTRAN, TurboPASCAL, and QuickBASIC. The two Device Drivers are; DV488PC.SYS and DV488UC.SYS for the IBM PC/XT/AT and PS/2, respectively. (See Appendix C for a complete file listing and brief description of each).

Installing DV488 Device Driver

Prior to operation of either the MBC-488 or uCMBC-488, the appropriate device driver (DV488PC or DV488UC) must be installed. This is done by running DVSETUP.EXE (supplied on your diskette). To run DVSETUP.EXE, type:

C:>DVSETUP<cr>

Once invoked, DVSETUP will prompt you for the (sub)directory containing DV488. Note that VIPARSE.SYS must be in the same (sub)directory. CONFIG.SYS is a readable file. It should look something like this.

```
BUFFERS = 20
FILES = 20
DEVICE = (path:)VIPARSE.SYS /HK=ALT H /MK=ALT M /SK=ALT TAB
DEVICE = (path:)DV488PC.SYS
```

If VI.SYS was selected (for PCIP instruments, see Appendix C) as the device driver, add the following line to CONFIG.SYS. It must be added before the line selecting VI.SYS.

DEVICE = (path:)ANSI.SYS

CONFIG.SYS is automatically executed at system (computer) start-up and installs the various device drivers required.

PROGRAM Mode of Operation

MetraByte's (uC)MBC-488 may be operated in one of two data transfer modes; a Programmed Mode and a DMA mode. The Programmed mode requires that DMA and Interrupt levels be disabled on the MBC-488 whereas the uCMBC-488 operates entirely via software so that nothing need be done in order to operate in either mode.

A set of image specifiers are used in conjunction with the ENTER/OUTPUT commands to format data prior to transfer to strings, integer variables, etc. These image specifiers also allow the addition of parity to ASCII data and control characters <cr> & <lf> for string data termination.

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APPENDIX D
DV488 FILE LISTING for MetraByte's uCMBC-488

The following is a complete file listing contained on the 3.5" diskette supplied with your uCMBC-488 board. This same listing is contained in "FILES.DOC" on the diskette.

System Files

DV488UC	SYS	GPIB Device Driver for PS/2 Models 50 thru 80
VIPARSE	SYS	Parse only support DOS DEVICE DRIVER
LPT	SYS	Printer/plotter Device Driver loaded by CONFIG.SYS
VI	SYS	Complete support DOS DEVICE DRIVER for parsing and use with Pop up screen instruments. This file is included to supply the latest version to current users of PCIP instruments.

Documentation, Utility and Executable Files

FILES	DOC	Directory of DV488 files on diskette
README	DOC	File containing update history
LPT	DOC	Operating instructions for printer/plotter driver
DVSETUP	EXE	Automatic setup of user's CONFIG.SYS file
@5018	ADF	PS/2 POS Configuration file
GENADF	EXE	Utility used to modify uCMBC-488 Base Adddress selection

BASIC Language Demo/Example Files

DVDMA	BAS	DMA Data Transfer
DVBL	BAS	Serial Poll with LOW BYTE Transfer
DVBH	BAS	Serial Poll with HIGH BYTE Transfer
DVSPOL	BAS	Serial Poll with STRING Transfer
DVB	BAS	Serial Poll with PACKED BYTE Transfer
DVFLUKE	BAS	Serial Poll with FLUKE 8840A DMM
PLTRTST	BAS	Control of Plotter DOS DEVICE DRIVER
HPEXAMPL	PLT	Example plot file that can be sent to a HP7475A plotter from DOS using HOT keys and the TYPE command via LPT.SYS

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