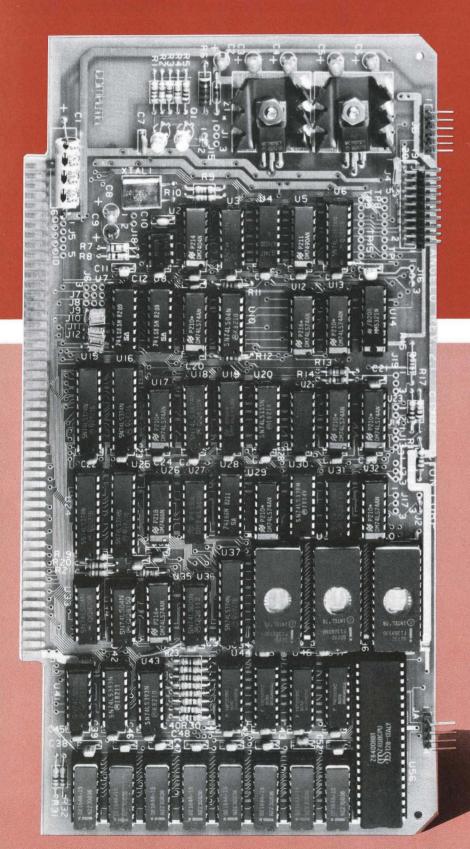


if the image is important.



MICROANGELO® MA520 GRAPHICS COMPUTER Technical Data

- Low Cost, Single Board Graphics Computer
- 512 x 480 Resolution
- Video Refresh Plus User Utility Memory
- ScreenWare™ Plots Graphics, Manages Text Display
- Easy-To-Integrate S-100 and Multibus* Versions

*Multibus is a trademark of Intel Corporation.

DATA FORMATS

MA520 receives data and commands from the host in 8-bit bytes. It interprets the data in the following format:

6

7

0

MODE

Text Mode
Graphics Mode

A "0" in the most significant bit causes MA520 to interpret the rest of the byte as an ASCII character, which it displays on the screen at the alpha cursor location. If the rest of the byte is one of the 14 ASCII control characters, the MA520 recognizes it and takes the appropriate action.

OPERATION

A "1" in the most significant bit indicates that the next 5 bits are a graphics operation code. There are 20 operation codes; one governs the text display, the rest control graphics. The remaining two bits indicate a mode within an operation (for example, mode 0 of operation 3 turns a designated point on, mode 1 turns it off.) To command MA520 from high level software requires nothing more than subroutines that translate high level instructions to several bytes of MA520 operation code and coordinate data. For instance, to draw a line takes just 5 bytes from the host to the MA520. A complete list of operations, modes and the bytes they require appears on the page opposite.

MEMORY SPACE

MA520 memory space is allocated as follows:

0000-3FFF PROM **4000-7FFF** User

8000-F800 Screen Image **F801-F93F** ScreenWare

F940-FD3F User

FD40-FFFF ScreenWare

Memory address from 4000 to 7FFF point to one of two 16K byte banks of RAM buffer. A command in ScreenWare lets the user switch from one buffer to another. The first of the two 16K banks has allocated 1.5K bytes for a user-defined character font or macros. The balance of this bank and the entire other bank is for the user and optional software expansions.

INTERCONNECTIONS/PORT ADDRESS

As shipped, the ports of MA520S (S-100 version) are mapped as F0H and F1H in your system's port address space. You can change the default addresses by modifying 2 port address jumpers. MA520M (Multibus version) is I/0 or memory mapped (jumperable) to any 2-port boundary of 256 ports (8080/Z80), any 2-port boundary of 64K ports (8086) or any 2-byte boundary of 1 meg address space.

The lower-addressed port is an 8-bit data port for data to and from MA520. The higher-addressed port is a control port for handshaking communication. Writing a "1" to the least significant bit of the control port causes the MA520 to reset.

INTERRUPTS

MA520 is shipped with three maskable interrupts enabled for data-to/from-host and lightpen-firing. Simple jumper connectors enable a maskable data-to-host interrupt and a non-maskable real time interrupt.

MA520 also generates signals that support interruptdriven protocols in the host via vectored interrupt lines on the S-100 or Multibus.

The second secon

MA520 has four pins for connecting a lightpen, as follows:

- Lightpen strobe (rising edge falling edge jumperable)
- 2. Ground
- 3. Lightpen enable (active high)

LIGHTPEN INTERFACE

4. Power source (100 ma, +5V)

For a lightpen without an enable signal, pins 3 and 4 can be jumpered together permanently enabling the pen.

ATTACHING A MONITOR

MA520 drives a composite video or direct drive monitor. Signals appear on 6 pins:

1. RS-170 composite video

2. Ground

3. TTL video

OI TIL VIGOO

4. Ground

5. Horizontal sync (TTL level)6. Vertical sync (TTL level)

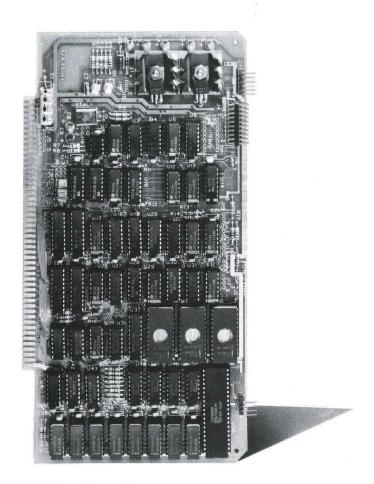
For Composite Video Monitor

For Direct Drive Monitor

MONITOR RECOMMENDATION

To take full advantage of the high-resolution signal MA520 produces, the video monitor should have a bandwidth of at least 15 MHz. Using a monitor with a long persistence P39 phosphor gives the best image with MA520 interlaced raster-scan signal. For lightpen operation, 7% infrared phosphor doping of the P39 is recommended.





SYSTEM OVERVIEW

MicroAngelo MA520 is a single board monochrome graphics computer with a Z80 microprocessor. It displays graphics with sharp, 512 x 480 pixel resolution. 30K bytes of RAM memory buffers the display and takes all the raster-scan refresh burden off the host system. The additional RAM memory you may use as you wish. ROM firmware contains ScreenWare, a graphics control package that manages the graphics and text on display and performs the hundreds of calculations needed to draw graphics elements. Text controls in ScreenWare recognize 128 ASCII text and control characters and produce an 85 character, 40 line text display. MA520 drives a TTL or composite video monitor. There is a lightpen interface on the board. S-100 and Multibus versions of MA520 are simple to integrate into any standard system.



SCREENWARE MANAGES GRAPHICS AND TEXT DISPLAY

GRAPHICS MODE

MA520 generates an image 512 pixels wide, 480 pixels high. Pixel coordinates run from 0-511, left to right, in the horizontal direction (X axis) and from 0-479, bottom-top, in the vertical (Y axis). Since it takes 9 bits to distinguish 512 (= 29) pixels, MA520 expects two bytes each for the X and the Y coordinates, with the high byte first. Graphics are clipped at screen edges.

MA520 automatically maintains 6 coordinate pairs: alpha cursor location (row, column), graphics cursor location (X,Y), the location of a second graphics cursor tied to the alpha cursor, tracking cross location, crosshair location and location of the last lightpen firing.

TEXT MODE

Graphics mode can put characters anywhere on the screen. In addition, MA520 provides a separate text cursor that writes up to 40 lines of text with 85 characters per line. The SPLITSCR command in ScreenWare can be used to limit the text cursor to the lower part of the screen. In text mode, lines are numbered from 0-39, top to bottom; characters from 0-84, left to right. The standard characters in ROM are 5 x 8 pixels in a 6 x 12 field. You can create a second character set using either the CHARACTER or MEMORY command. The ALPHAMODE command sets figure/ground, overstrike, underline and complement options.

COMMAND NAME	MODE	NUMBER OF BYTES FROM HOST	FUNCTION
GRAPHICS PRIMITIVES			
	0	5	Turn point off
POINT	1	5	Turn point on
	2	5	Complement point (turn off, if on; turn on, if off)
RPOINT'	3	5	Read point (1 byte to host)
RVECTOR 1 RREGION 1	0	5	Turn vector off
		5	Turn vector on
	2	5	Complement vector
VECTOR REGION	0	9	Turn rectangular region off
	1	9	Turn rectangular region on
	2	9	Complement rectangular region
CIRCLE	0	2	Turn circle off
	1	2	Turn circle on
	2	2	Complement circle
FLOOD ²	0	5	Flood bordered region with zeroes (can be any point inside region)
	v 1	5	Flood with ones
	2	5	Flood relative with zeroes
	3	5	Flood relative with ones

COMMAND	MODE	NUMBER OF BYTES FROM HOST	FUNCTION
NAME		FROM HOST	FUNCTION
TEXT AND CHARACTERS	0	2	Establish alpha display functions
ALPHAMODE	1	3	Position alpha cursor
ALPHAWODE	2	1	Read alpha cursor (2 bytes to host)
	3	2	Set number of lines to scroll at screen end
	0	2	Write character at graphics cursor
CHARACTER	1	2	Set orientation, size and figure/ground of graphics character
OHAHAOTEH	2 ³	14	Define alternate character
	3	1	Load default character font to user memory (for modification)
	0	2	Limit alpha screen to specified lines at lower end of screen
SPLITSCR	1	9	Define special ASCII control codes
	2	1	Ignore or don't ignore linefeed
SCREEN AND CURSOR CONTROLS			
CONTROLS	0	5	Position graphics cursor
GCURSOR	1	1	Read graphics cursor (4 bytes to host)
aconton	2	1	Tie graphics cursor to alpha cursor
	3	1	Tie graphics cursor to tracking cross
RGRAPHIC	0	5	Move graphics cursor relative to present position
	0		Clear screen
SCREEN	1	2	Set figure/ground
SCHEEN	2	1	Toggle figure/ground
	3	1	Read figure/ground (1 byte to host)
	0	1	Turn tracking cross off
LIGHTPEN	1	5	Turn tracking cross on
LIGHTILL	2	1	Read tracking cross (1 or 5 bytes to host)
	3	1	Read lightpen (1 or 5 bytes to host)
	0	1	Turn crosshairs off
CROSSHAIRS	1	5	Draw crosshairs at specified location
CHOOSHAINO	2	1 1	Read crosshairs (4 bytes to host)
	3	1	Draw crosshairs at graphics cursor location
USER FUNCTIONS	0	2	Start/Stop definition of a series of commands as a macro command (1 byte to host)
MACRO ³	1	2	Add next byte to macro (1 byte to host)
	. 2	2 or 4	Erase macro or clear facility (1 byte to host)
	3	2	Invoke macro command
	0	1	User defined
USER	1	1 3 2 1	User defined
	2	1	User defined
	3	1	User defined
UTILITIES	0	1	Read out entire screen (left to right, top to bottom) (7800H to host)
MEMORY	1	7801H	Load entire screen (left to right, top to bottom)
	2	5	Read out y bytes of MA520 memory (y bytes to host)
	3	3 + x	Load x bytes to MA520 memory
	0	3	Set memory address of user command (see USER)
UTILITY	1	6	Give user code control of MA520 CPU
	2	2 or 4	Enable or disable real-time interrupts
	3	1	Force cold start (no data saved)
	0	2	Test EPROM by checksums (1 byte to host)
TEST	1	1	Test RAM by storing and reading every byte value at ever memory location (1 or 5 bytes to host)
	2 .	1	Alpha test by displaying entire default font
	3	4	Munching squares (moving display for adjusting monitor)

¹RPOINT, RVECTOR and RREGION operate relative to the current position of the graphics cursor.

²FLOOD requires a region completely bordered with ones or zeros, and the interior must be all zeros or all ones.

³The user-defined character font and macros share 1.5K bytes of user memory space.

SPECIFICATIONS

BOARD: S-100 (Model MA520S) or Multibus (Model MA520M)

RESOLUTION: 512 horizontal x 480 vertical (jumperable to

448)

CHARACTER DISPLAY: 85 columns, 40 lines

ALPHANUMERICS: Normal — 5 x 8 pixels in 6 x 12 field. Double — 10 x 16 pixels in 12 x 24

field. ASCII upper and lower case characters and controls standard in

REFRESH RATE: 30 Hz interlaced

PROCESSOR: Z80, 5 MHz

MEMORY: RAM: 64K bytes. 30K bytes display refresh,

32K bytes user, 2K bytes scratchpad (2K bytes additional scratchpad if 448

vertical resolution selected).

EPROM: Up to 12K bytes (MA520) up to 16K bytes (MA520M), 8K bytes for ScreenWare, remainder for expansion

and user utility

CLOCK: 60 Hz interrupting real-time clock

POWER: **MA520S**

MA520M 1 amp at +8V unregulated 1 amp at + 5V35ma at -18V unregulated 35 ma at -12V

S-100 Bus Connections

S-100 PIN

50 Ground	Ground 100
49	99
48	98
47	97
46 Input request	96
46 Output request	Inbound data 0 95
44	Inbound data 1 94
43 Inbound data 7	Inbound data 6 93
42 Inbound data 3	Inbound data 5 92
41 Inbound data 2	Inbound data 4 91
40 Outbound data 6	Outbound data 7 90
39 Outbound data 5	Outbound data 3 89
38 Outbound data 4	Outbound data 2 88
37	87
36 Outbound data 0	86
35 Outbound data 1	85
34	84
33	Address line 7 83
32	Address line 6 82
31	81
30 Address line 4	Address line 1 80
29 Address line 5	Address line 0 79
28	Input strobe 78
27	Output strobe 77
26	76
	Power -18V 52
1 Power + 8V	Power + 8V 51

Multibus Connections

PIN	PIN
1 Ground	2 Ground
3 Power +5V	4 Power +5V
5 Power + 5V	6 Power +5V
7	8
9	10
11 Ground	12 Ground
13	14 Initialize
15	16
17	18
19 Memory read command (memory mapped)	20 Memory write command (memory mapped)
21 I/0 read command (I/0 mapped)	22 I/O write command (I/O mapped)
23 Transfer acknowledge	24 Inhibit 1 disable RAM (memory mapped)
25	26
27	28 Address 10
29	30 Address 11
31 Constant clock	32 Address 12
33	34 Address 13
35 Interrupt 6	36 Interrupt 7
37 Interrupt 4	38 Interrupt 5
39 Interrupt 2	40 Interrupt 3
41 Interrupt 0	42 Interrupt 1
43 Address E	44 Address F
45 Address C	46 Address D
47 Address A	48 Address B
49 Address 8	50 Address 9
51 Address 6	52 Address 7
53 Address 4	54 Address 5
55 Address 2	56 Address 3
57 Address 0	58 Address 1
59	60
61	62
63	64
65	66
67 Data 6	68 Data 7
69 Data 4	70 Data 5
71 Data 2	72 Data 3
73 Data 0	74 Data 1
75 Ground	76 Ground
77	78
79 Power -12V	80 Power -12V
81 Power +5V	82 Power + 5V
83 Power + 5V	84 Power +5V
85 Ground	86 Ground



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