

III. SETUP OF OPERATING PARAMETERS

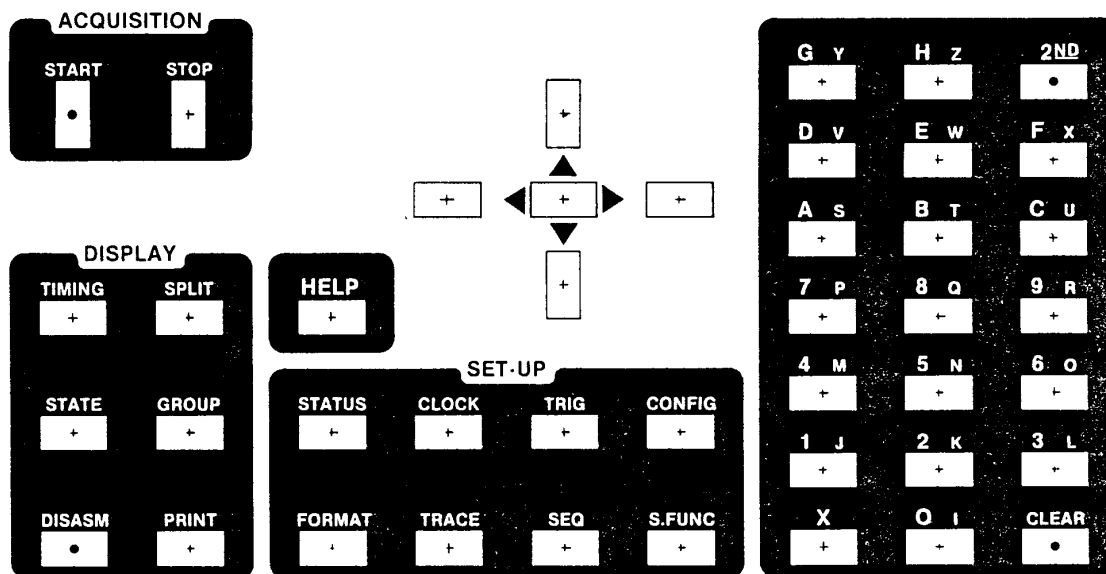
WARNINGS

BEFORE PLUGGING IN THE ML4400 TO AN AC POWER SOURCE, VERIFY THAT THE CORRECT VOLTAGE (115 OR 230) HAS BEEN SELECTED VIA THE VOLTAGE SELECTOR SWITCH AT THE LOWER RIGHT OF THE REAR PANEL.

DO NOT INSERT OR REMOVE ANY CAPTURE MODULE, AND DO NOT CONNECT OR DISCONNECT ANY LOGIC POD OR MICROPROCESSOR POD FROM THE ML4400, WITHOUT FIRST POWERING DOWN THE ML4400 VIA THE POWER SWITCH AT THE LOWER RIGHT OF THE REAR PANEL.

Figure III-A

ML4400 KEYBOARD



44-003

NOTE: See Sections IV-A and IV-B, under "Operation", for a full discussion of keyboard functions and editing (cursoring, scrolling, marks, etc.).

A. GENERAL

1. SETUP KEYS AND SCREENS

Before recording data on the ML4400, the user will usually want to specify a particular set of operating (data collection) and display parameters. Most of these machine setup parameters are specified via six of the eight Setup keys on the ML4400 front panel, each of which accesses a Setup screen. These six Setup keys and their screens, discussed in this section of the manual, are:

| Key Name | Screen Name(s) | Default OK To Use? |
|-------------|---------------------------------|-----------------------|
| ----- | ----- | ----- |
| FORMAT | Format Display | Usually |
| CLOCK | Clock | Sometimes |
| TRACE | Trace Control | Usually |
| TRIG | Trigger Words | Not usually |
| SEQ | Trigger Sequence, User Sequence | Often |
| CONFIG | Configuration | Usually |

[NOTE: Users of Arium's earlier ML4100 logic analyzer will recognize most of these six keys, with one minor difference; the function called "DELAY" on the ML4100 is called "TRACE" on the ML4400.]

Of the remaining two Setup keys, the STATUS key accesses the passive Status screen, which presents a "read-only" synopsis of the current machine setup and is the default screen displayed at ML4400 powerup. And the S. FUNC key accesses a variety of miscellaneous, less frequently used screens, both interactive and passive, which are discussed in Sections VIII and IV-F, G, and H of this operating manual.

Each of the six Setup screens, as well as the Status screen, displays the parameters as specified for the active logic analyzer group (A, B, C, or D). For a full discussion of the definition and operation of groups, see Section III-B, below.

2. CONTENTS OF THE SETUP SCREENS

The next-to-the-top line of all screens is the "Header line", and is displayed in reverse video. The Header contains (from left to right): the name of the screen; the label (A-D) and name of the active Group; and the current the date and time. (The group may be specified by the user, but if not, defaults to the type of Logic or Microprocessor Pod which is installed.) The Status screen, which is automatically displayed at powerup, carries the Arium copyright banner instead of a screen name.

The Header line also carries temporary messages, such as operating status ("ACTIVE"), error messages, and Stopwatch times, which overwrite part of this line while displayed. The blinking "ACTIVE" message indicates that data is being recorded; during this time, setup parameters may be viewed on each Setup screen, but not changed. Recording must be stopped before any setup parameter may be changed.

Each of the above six Setup keys calls up a screen offering parameter selections and/or setup information. Changeable fields (those in which values can be set or edited by the user) are highlighted in reverse-video. The cursor position blinks, and, when moved around the screen, the cursor automatically skips over nonchangeable or automatically set fields.

3. SPECIFYING SETUP PARAMETERS

At powerup, the ML4400 automatically defaults to appropriate operating and display parameters, depending upon exactly which Capture Modules and Pods are installed, so that data may be immediately collected and displayed. User-specified setup parameters may be automatically saved in battery-backed-up RAM; see the Setup File Storage screen, accessed via the S. FUNC key.

To select or change a setup parameter, first move the cursor (via the arrow keys) to the parameter's field. Each parameter may then be set in one of two ways: the user may select from a limited number (usually 2 or 3) of preset options via the keypad or softkeys, or may enter the parameter's actual value (usually numeric) via the keypad.

As soon as a parameter has been set, any other parameter dependent upon it is automatically updated and displayed, usually immediately after the cursor has left the field of the first one.

The softkeys (referred to generally as "F1" through "F6", from left to right) are labeled on the bottom line of the CRT screen; their functions and labels vary, depending upon which screen or screen function has been accessed.

The keypad contains 21 keys which access two sets of alphanumeric characters and functions. The primary character set contains ten digits (0-9), the letters A-H, a 2ND key, an X key, and a CLEAR key. The secondary set, accessed by first depressing 2ND, contains the letters I-Z and the ASCII space character. (The X key differs in function from the alphanumeric "X" in the secondary set.)

The letter Z on the keypad has a special function on the ML4400 screens. It represents the "last result" of the Calculator, and will automatically enter that number into any numeric field. To enter the Calculator's last result into a numeric field, cursor to the desired field and depress Z (2ND, H).

NOTE: For a full discussion of keyboard functions and editing (cursoring, scrolling, marks, etc.), see Sections IV-A and IV-B, under "Operation", and the onscreen "Editing Fields" Help topic.

B. GROUPS

1. DEFINING A GROUP (See Section III-D, "Configuration Setup Screen")

The ML4400 may be configured to act as up to four separate logic analyzers, with each analyzer called a "group", and labeled A, B, C or D. In addition to a label, each group may also have a name specified by the user via the Configuration Setup screen. The default name is the group's pod (e.g., LP4400 or 68000).

A group is defined by the Capture Modules it contains; the ML4400 accommodates up to four Capture Modules, which may be grouped separately or together. Groups are defined in the Configuration Setup screen, accessed via the CONFIG key; for details, see Section III-D.

2. GROUP OPERATING AND DISPLAY PARAMETERS

Each group has its own particular set of specified operating and display parameters, such as trigger words, trigger sequence, search words, and display format. (These group settings are automatically saved in battery-backed-up RAM.) Therefore, each Timing, State or Disassembly Display screen relates only to the particular analyzer group which is currently active, and the label and name of that group appear on the Header line of these screens.

Parameters specified in the Configuration, Set Date/Time/Misc., and RS232C Settings screens are common to all groups. Groups can function independently or they can arm and/or cross-trigger one another (see Section III-I, "Trigger Sequence Setup Screen"). Timing, State and Disassembly Display screens may be split to enable the user to easily compare time-aligned trace in one group with that in another (see Section IV-D.5, "Split-Screen Display").

To view the specified parameters for each active group, depress GROUP while in any Setup screen, which rolls the display from one group to the next. To change the group for which data is displayed (while in a Display screen) depress GROUP, which rolls the display from one group to another. To define the operating and display parameters for a group, and to select the Clock Source (one of the Capture Modules), use the Configuration Setup screen, accessed via the CONFIG Setup key. (See Section III-D, "Configuration Setup Screen".)

The group width is selected in the Format Display Setup screen (and displayed on the Configuration screen). User choices for the group width (number of channels) depend upon the group configuration (type of pod used and the number of Modules grouped together) as set in the Configuration screen. For example: Four HS-4400s (High-Speed Capture Modules) are grouped together; each is connected to an LP-8200 (200-MHz Logic Pod), which provides 8 channels at 200 MHz or 16 channels at 100 MHz. Because four Modules are grouped together, the width choices are 32 channels at 200 MHz, or 64 channels at 100 MHz.

The group depth (Trace Buffer depth) is calculated automatically from the group width; the wider the configuration, the shallower the depth.

The maximum clock rate (speed) for each record width varies from 400 MHz (for 4 channels) to 25 MHz (for 80 channels). The following chart shows the relationships between record width (channels), clock rate (speed in MHz), and record depth (samples/words).

Figure III-B

RECORD WIDTH, CLOCK RATE, AND RECORD DEPTH

| Capture Module/Pod | Record Width (in bits/channels) | | Maximum Clock Rate (in MHz) | Group Record Depth (in samples) | |
|-------------------------|------------------------------------|------------|-----------------------------------|---------------------------------------|--------|
| | 1 Group | 4 Groups | | | |
| HS-4400/LP-4400 | 4 | Async | 16 | 400 | 32,767 |
| HS-4400/LP-8200 | 8 | Async | 32 | 200 | 16,383 |
| HS-4400/LP-4400 | 16 | Sync/async | 64 | 100 | 8,191 |
| or HS-4400/LP-8200 | | | | | |
| SC-4400/LP-4050 | 20 | Async | 80 | 100 | 8,191 |
| SC-4400/LP-4050 | 40 | Sync | 160 | 50 | 4,095 |
| SC-4400/LP-4050/LP-8025 | 80 | Sync/async | NA | 25 | 2,047 |

C. STATUS SCREEN (via STATUS Key)

The Status screen acts as a base of operations for the ML4400 user. It is a passive screen which only presents information, as compared with the six Setup screens, which are interactive screens via which the user can select and change operating parameters.

The Status screen is displayed automatically at powerup. Its Header line does not carry the screen name, but instead displays "c 1988, ARIUM CORP." at the left.

The Status screen gives an overall synopsis of the six Setup screens by showing how the ML4100 is currently set up for the active logic analyzer group, i. e., the major setup parameters that have been selected (or defaulted to) on each of the Setup screens. It is often useful to view all these major parameters at once on this screen, rather than to view them a few at a time as they are shown on each individual Setup screen. However, the user will want to move to the other Setup screens to view these parameters in greater detail, and the user must move to these other screens to select and change the parameters.

To view overall major system parameters on the Status screen, depress the STATUS key.

To change the Status screen display from one logic analyzer group to the next, depress the GROUP Display key, which rolls through Groups A, B, C, and D. (See Section III-B, above, for a full discussion of groups.)

To view system parameters in greater detail than is shown on the Status Setup screen, to set up the ML4400 for initial operation, or to change any detailed system parameters while using the ML4400, use the Setup keys (described in Figure III-D, below).

Figure III-C

STATUS SCREEN

```

©1988, Arium Corporation
©1988. ARIUM CORP. Group B: 8085 Jul 22, 1988 3:28pm
CLOCK
Source      : External
Timestamp   : 50 ns
TRACE CONTROL
DELAY       : 2047 clks
DATA QUAL type: off

CONFIGURATION
Name      Cards  Clk  Width  Depth
Group B:  8085   1    1   040   04005

SEQUENCE
A then B then C then D
Arm seq on group: START Trigger on group: B

TRIGGER WORDS
EXT  STS      ADR  DAT
A: XXXX 0011  004E XX
B: XXXX XXXX  004F XX
C: XXXX XXXX  0050 XX
D: XXXX XXXX  0100 XX

FORMAT Pod: 8085
  
```

Figure III-D

ML4400 SETUP KEYS

| Setup Key (and Screen) | Setup Parameters |
|---|--|
| FORMAT (Format Display) | Display format for recorded data: number base, probe ranges, data sense (inversion/noninversion), and mode of Microproc. or Logic Pod (data width) |
| CLOCK (Clock) | Selection of internal/external clock, data recording rate for internal clock, and TimeStamp period |
| TRACE (Trace Control), TRIG (Trigger Words), & SEQ (Trigger Sequence & User Sequence) | Trigger condition (which stops the data recording process), including trigger words, trigger sequence, trace delay, and data qualification |
| CONFIG (Configuration) | Configuration of logic analyzer groups: Capture Modules, group names, clock sources, and voltage thresholds |

Figure III-E

SETUP PARAMETER CHOICES
(STATUS SCREEN)

NOTE: Not all of the fields below are displayed on this screen at once; the exact fields displayed depends upon user selections in other Setup screens, such as internal/external clock, data qualification type, and active Pod type.

CLOCK:

Source: External or Internal
Period: 20 ns - 200 ms (for Internal Clock)
Master clock: 1, 2, 3, or 4 (Clock Source)
Slave clock: 1, 2, 3, 4, or Off (Clock Source)
Slave bytes: 0, 1, 2, or 4 (Number of bytes clocked by Slave Clock)
Qual. valid: Always, Low or High
Timestamp: 50 ns, 100 ns, 1 us, 10 us, 100 us, 1 ms, or 10 ms

CONFIGURATION:

Group: A, B, C, or D (Label of currently selected group)
Name: (Group name)
Cards: 1, 2, 3, and/or 4 (Capture Modules in selected group)
Clk: 1, 2, 3, or 4 (Capture Module providing the Clock)
Width: (Trace width)
Depth: (Trace depth)

SEQUENCE:

(Any of up to 27 predefined sequences, or
a user-defined sequence)
Arm on: <START>, or A, B, C, D, and/or X (external); (Condition
at which to arm Trigger Sequence)
Trigger on group: A, B, C, or D (Cross-trigger condition)

TRIGGER WORDS:

(Maximum of 4 can appear on this screen)
A: (Full definition if other than all Don't Cares)
B: (Full definition if other than all Don't Cares)
C: (Full definition if other than all Don't Cares)
D: (Full definition if other than all Don't Cares)

TRACE CONTROL:

DELAY: 0-99999 clocks (Both on trigger and on stopping trace) ?
DATA QUAL. type: Comb, State, or Off

(For State only:)

Trace: Only or All but
Occurrences of: None, or (include/not) A-H (up to 4 Trigger words)

(For Comb. only:)

Begin w/trace: Enabled or Disabled
Disable on: None, or (include/not) A-H (up to 4 Trigger words)
Enable on: None, or (include/not) A-H (up to 4 Trigger words)

FORMAT Pod:

8085, 8035/9, or 8031/2 (for 8085 pod);
LOGIC20, LOGIC40...LOGIC160; etc.

D. CONFIGURATION SETUP SCREEN (via CONFIG Key)

To access the Configuration Setup screen, depress the CONFIG Setup key. The available softkeys are (from left to right) INCREASE VALUE (F3) and DECREASE VALUE (F4). This screen is used to name and define logic analyzer groups, to specify each group's clock source, and to set voltage thresholds for the Logic Pods.

1. GROUPS

An ML4400 system may be configured as up to four separate logic analyzers. Each analyzer is called a group (and labeled A, B, C or D). The ML4400 can accommodate up to four Capture Modules (SC-4400s and/or HS-4400s), grouped separately or together.

A group also contains one to four Logic and/or Microprocessor Pods. System memory depth varies from 2,047 to 32,767 cycles, depending upon the data width (number of channels) and type of Pod.

Examples of groups are:

Example 1: The ML4400 contains 4 SC-4400s (Standard Capture Modules), each connected to an LP-4050 (100-MHz Logic Pod, 20 channels at 100 MHz or 40 channels at 50 MHz). These modules may be configured as 4 analyzer groups, or, more conveniently, as one large group capable of 80 channels at 100 MHz or 160 channels at 50 MHz.

Example 2: The ML4400 contains 4 SC-4400s, each connected to a Microprocessor Pod. There are 4 groups, because Microprocessor Pods cannot be grouped with anything. The mix of Micropods is unlimited; all 4 could be 68020s, or there could be one each of 68020, 8086, 6502, and 8085 Micropods.

Example 3: The ML4400 contains an SC-4400 connected to a 68000 Micropod, plus an HS-4400 (High-Speed Capture Module) connected to an LP-4400 (400-MHz Logic Pod). There are 2 groups: the 68000 group, and the LP-4400 (high-speed) group; either group can cross-trigger the other.

2. GROUP NAME

The user may give each of the four logic analyzer groups a name, which will then automatically be displayed just after the Group Label (A-D) on each screen's Header line. To name a group, cursor to the appropriate "Name" field and use the keypad to enter the desired alphanumeric characters (up to 6). The default name is the Pod name (LP4050, 68000, etc.).

Figure III-F

CONFIGURATION SETUP SCREEN

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CONFIGURATION Group A: LP4050 Oct 26, 1988 6:29pm

CURRENT INPUT CARD GROUPING:

| Group | Name | Card(s) / Input | CLK Src | Width* | Depth |
|-------|--------|-----------------|---------|------------|-------|
| A | LP4050 | 2 | 2 | 20 (20,40) | 8190 |
| B | | (off) | | | |
| C | | (off) | | | |
| D | | (off) | | | |

* set in FORMAT Screen

INSTALLED CARDS/PODS:

| Slot | Card | Pod | Threshold |
|------|--------|--------|------------|
| 1 | ---- | ---- | |
| 2 | SC4400 | LP4050 | +1.40V TTL |
| 3 | SC4400 | ---- | |
| 4 | ---- | ---- | |

SET VOLTAGE THRESHOLD:
-2.50v to +9.95v (.05v)
Press X to toggle +/-
Standard settings:
A=TTL, C=CMOS, E=ECL

SELECTABLE CARD/POD COMBINATIONS

| HS4400 (High-speed card) | SC4400 (Standard card) |
|--------------------------|-------------------------|
| LP4400 - 4 ch / 400 MHz | LP4050 - 40 ch / 50 MHz |
| LP8200 - 8 ch / 200 MHz | LP8025 - 80 ch / 25 MHz |

| | | INCREASE VALUE | DECREASE VALUE | | |
|--|--|-------------------|-------------------|--|--|
| | | | | | |

3. GROUP DEFINITION (CAPTURE MODULES)

The middle of the Configuration screen lists the installed Capture Modules by Capture Module slot number. (These slots are numbered 1-4, from top to bottom.) The user may assign each Capture Module to a particular group. A group may contain more than one Module if the Module is connected to LP-4400, LP-8200, and/or LP-4050 Pods; the LP-8025 Expansion Logic Pod and the Microprocessor Pods may not be grouped together. Only identical Capture Module/Pod sets may be ganged in one group. Two groups cannot contain the same Capture Module.

Groups are defined from the "Card(s)/Order" field. The order in which the Modules are listed in this field is very important; the first Module contains the most-significant probe numbers, and the last Module listed contains the least-significant ones. For example: Two LP-4050 Pods are connected to SC-4400 Capture Modules installed in Slots 1 and 2, and the "Card(s)/Order" Field" is set to 2+1. The Pod connected to Module 2 contains Probes 79-40, and the Module 1 Pod contains Probes 39-0 (assuming that the Group width is set to 80).

To specify the Capture Modules for a group, cursor to the appropriate "Card(s)/Order" field and use the keypad to enter the slot number(s) (1-4) of the desired Module(s). To exclude a Capture Module from a Group, depress its slot number again (i.e., the 1-4 keys toggle the number displayed on and off).

4. GROUP CLOCK SOURCE

After defining a group by specifying one or more Capture Modules in the "Card(s)Order" field, the user may specify which Module's clock inputs will be used to clock the entire group. To specify the group clock source, cursor to the appropriate "Clk Src" field and use the keypad to enter the Slot number(s) (1-4) of the desired Module(s).

NOTE: A trigger range (defined on the Trigger screen) can be used only within the Capture Module which is providing the clock source for the group.

5. GROUP RECORD WIDTH (AND MEMORY DEPTH)

The group record width is set automatically when the Pod mode is selected (in the Format Display Setup screen, per Section III-E). The possible widths are listed in parentheses in the "Width" field; they depend upon the type of Pod being used and the number of Capture Modules grouped together.

The group depth (Trace Buffer depth) is calculated automatically from the group width; the wider the configuration, the shallower the depth.

6. VOLTAGE THRESHOLD FOR LOGIC PODS

The user may select a standard voltage setting according to the logic family (TTL, CMOS, or ECL), or specify a voltage threshold for each group's Microprocessor or Logic Pod. The "Threshold" field is in midscreen, in the "Installed Cards/Pods:" section.

The standard thresholds are +1.40 V for TTL, +2.50 V for CMOS, and -1.50 V for ECL. Default is +1.40 V.

The user-settable voltage threshold ranges depend upon the resolution, which is jumper-selectable in the Pod at either .10 or .05 volts. For a resolution of .10 volts, the range is -9.9 to +9.9 volts; for a resolution of .05 volts, the range is -2.1 to +9.9 volts. SCREEN AND SPECS SAY "-2.5 VOLTS"...??? ?

To select a standard threshold voltage setting, cursor to the appropriate "Threshold" field and enter A (TTL), C (CMOS), or E (ECL).

To specify the voltage threshold for a Logic Pod, cursor to the appropriate "Threshold" field and use the keypad to enter a decimal value between -9.90 and +9.90 volts; depress the X key to toggle between "+" and "-". Values may also be changed via the INCREASE and DECREASE softkeys.

E. FORMAT DISPLAY SETUP SCREEN (via FORMAT Key)

To access the Format Display Setup screen, depress the FORMAT key. This screen is used to view and select formats for displaying data on the Timing, State, and Trigger Words screens. (The Trigger Words screen uses the same display format as the State Display screen.)

Softkeys F1 through F5 are labeled as needed with the available Pod modes for the particular Logic or Microprocessor Pod which is being used; the F6 softkey is labeled ROLL TIMING PG.

Data may be displayed in any of five number bases: binary, octal, decimal, hexadecimal, or equivalent ASCII values, and it may be displayed inverted or noninverted. All displayed data may be reformatted or redisplayed on any of the Display screens without recapturing (re-recording) it; this is especially convenient for displays in which a different base or bit grouping is needed.

The Timing and State displays may comprise entirely different combinations of probes.

Figure III-G

FORMAT DISPLAY SETUP SCREEN

```

©1988, Arium Corporation                                ML4400
FORMAT DISPLAY      Group A: 68000      Jul 22, 1988      6:17pm
TIMING:            !--- Page 1 ---!--- Page 2 ---!
Line               13  14  15  16  13  14  15  16
Base               OFF OFF OFF OFF OFF OFF OFF OFF
High probe         00  00  00  00  00  00  00  00
Low probe          00  00  00  00  00  00  00  00
Data sense         NON NON NON NON NON NON NON NON

STATE:             EXT STS ADR DAT
Field              1   2   3   4   5   6   7   8   9  10  11  12
Base               OFF BIN OFF BIN OFF HEX OFF HEX OFF OFF OFF OFF
High probe         00  30  00  70  00  63  00  15  00  00  00  00
Low probe          00  24  00  64  00  40  00  00  00  00  00  00
Data sense         NON INV NON INV NON INV NON INV NON NON NON NON

Bases: A=ASC B=BIN C=OCT D=DEC H=HEX F=OFF G=ON
Senses: 0=NON (noninverted), 1=INV (inverted)

POD MODE (also sets defaults): 68000T

68000T  68000F  68000MP  [ ]  [ ]  ROLL
[ ]  [ ]  [ ]  [ ]  [ ]  TIMING PG
  
```

1. FORMAT FOR TIMING DISPLAY SCREEN

The timing line display format is specified on the upper portion of the Format Display Setup screen. Each group of fields (from left to right) corresponds to a timing line displayed on the Timing Display screen.

There are 32 timing line definitions, corresponding to up to 16 timing lines displayed on each of the first two pages of the Timing screen. Only 12 of these definitions are shown on the Format Display screen at once. To scroll through the other timing line definitions, use the ROLL TIMING PG softkey. The number of the page being displayed appears on the line below the Header line, to the right of the "Timing:" label.

If the last eight lines of a timing display page are turned off, the timing lines are automatically displayed double-high.

Each timing line definition consists of a number base, a probe range, and a data sense. A timing line may be defined to be a single probe or (for address and data buses) a range of probes.

To define a single probe timing line, enter the desired probe number in the "High probe" field. The "Low probe" field will be automatically set to the same value as the "High Probe" field, and the number base will be set to "on".

To define a probe range as a timing line, first select a number base by entering "A" (ASCII), "B" (binary), "C" (octal), "D" (decimal), or "H" (hexadecimal) in the "Base" field. Next enter the desired probe range in the "High probe" and "Low probe" fields; (these probe numbers are consecutive, with the low number being the least-significant bit). Then select the data sense by entering "0" (noninverted) or "1" (inverted). Inverted probe ranges display the 1's complement of the data.

The same data may be displayed in more than one line. The maximum number of bits in a range is 32.

2. FORMAT FOR STATE DISPLAY SCREEN (and Trigger Words Setup screen)

(The Timing and State displays may comprise entirely different combinations of probes.)

The State display format setup fields appear in the middle of the Format Display Setup screen. There are 12 field definitions, corresponding to up to 12 columns of data displayed in the State screen. A state field definition consists of a field label, a number base, probe range (including a single probe) and data sense. The State field definitions determine the display format of the Trigger Words Setup screen as well.

To label a state field, enter a 3-character label in its "STATE:" field. (This label will also appear as a field heading in the State Display screens.)
To clear a state field label, depress CLEAR while in the field.

To define a state field, first select a number base (or disable the field) by selecting A (ASCII), B (binary), C (octal), D (decimal), or H (hexadecimal) in the "Base" field. To disable a state field definition, enter "F" (off).

Next specify its probe range by entering the desired probe numbers (inclusive) in its "High probe" and "Low probe" fields. (The probe numbers on the logic pods refer to the input data channel numbers.) The probe range thus established by these fields is consecutive, with the low number being the least-significant bit.

Then select the data sense by entering 0 (noninverted) or 1 (inverted) in its "Data sense" field. Inverted fields will display the 1's complement of the data in the selected number base.

Data may be displayed in more than one field, and fields may overlap. The maximum number of bits in a range is 32.

If the ML4400 is connected to a microprocessor, then four fields are automatically defined; Field 2 is the external probe (and is labeled "EXT"), Field 4 is the status line ("STS"), Field 6 is the address bus ("ADR"), and Field 8 is the data bus ("DAT"). The number base of the "ADR" and "DAT" fields are set to "Hex" for hexadecimal display on the State Display screen. The default values in these fields depend upon which type of Microprocessor Pod is in use.

3. POD MODE

The "POD MODE" field near the bottom of the screen displays the currently selected pod mode. The number of available pod modes depends upon the type of pod being used.

To select a particular pod mode, cursor to the "POD MODE" field and depress the appropriate softkey, then depress the softkey again to verify the selection. (See Figure III-H for currently available pod mods.)

If the pod mode is changed, certain settings are modified or lost. The Trace Buffer width is changed to match the new pod mode; if the new width is dif-

ferent from the old width, then the Trace delay is set to half the depth, the trigger words are cleared, and trace data is lost. The State format fields are set to defaults, and invalid timing line definitions are cleared. If the internal clock period value is now invalid, it is forced to a valid value.

Figure III-H

ML4400 POD MODES

| Pod Cat. No. | ML4400 Mode Designation | Supports |
|-----------------|----------------------------|---|
| LP-4050 | LOGIC20, 100-MHz | 20-channel operation, 2 trigger words |
| | LOGIC40, 150-MHz | 40-channel operation, 4 trigger words |
| | SLOW40, 25-MHz | 40-channel operation, 8 trigger words |
| LP-8025 | LOGIC 80 | 80-channel operation, 8 trigger words |
| LP-8200 | LOGIC8, 200-MHz | 8-channel operation, 2 trigger words |
| | LOGIC16, 100-MHz | 16-channel operation, 4 trigger words |
| | GLITCH8, 100-MHz | 8-channel operation, 4 trigger words, glitch capture |
| LP-4400 | LOGIC4, 400-MHz | 4-channel operation, 1 trigger word |
| | LOGIC16, 100-MHz | 16-channel operation, 4 trigger words |
| 8I-080 | 8085 | 8085 |
| | 8035/9 | 8035, 8039, 8048 |
| | 8031/2 | 8031, 8032, 8051, 8052 |
| 8M-080 | 6800 | 6800 |
| | 6802 | 6802, 6808 |
| 8M-089 | 6809 | 6809 |
| | 6809E | 6890E |
| 8N-080 | NSC800 | NSC800 |
| | NSCREFR | NSC800, refresh recorded |
| 8R-065 | 6502/8 | 6502 |
| | 6512 | 6512 |
| | 65C112 | 65C112 |
| | 65CX02 | 65C02, 65C102 |
| 8Z-080 | Z80 | Z80, Z80A, Z80B, Z80C |
| | Z80REF | Z80, Z80A, Z80B, Z80C, refresh recorded |
| 16I-086 | 8086 MIN | 8086, minimum mode |
| | 8086 T | 8086, maximum mode, transparent |
| | 8086 JMP | 8086, maximum mode, jump |
| | 8086 F | 8086, maximum mode, filtered |
| | 8088 MIN | 8088, minimum mode |
| | 8088 T | 8088, maximum mode, transparent |
| | 8088 JMP | 8088, maximum mode, jump |
| | 8088 F | 8088, maximum mode, filtered |
| 16M-680 | 68000T | 68000, transparent |
| | 68000JMP | 68000, jump |
| | 68000F | 68000, filtered |
| | 68010T | 68010, transparent |
| | 68010JMP | 68010, jump |
| | 68010F | 68010, filtered |
| 32M-682 | 68020DIS | 68020, disassembly (probes disabled) |
| | 68020PRB | 68020, probes enabled (no disassembly) |
| 8RS-232 | RS232 | RS-232C |
| | RS232TIM | RS-232C, timing |

F. CLOCK SETUP SCREEN (via CLOCK Key)

To access the Clock Setup screen, depress the CLOCK key. This screen displays the internal and external clocking parameters, and is used to select and change all clock parameters, including a TimeStamp period. Softkeys F1-F3 are labeled with available Pod modes (Logic pods only); the others are INTERNAL CLOCK (F4), EXTERNAL CLOCK (F5), AND ROLL TIMEBASE (F6).

An internal clock is used when analyzing logic, hardware and timing problems; an external clock, for analyzing bus problems and software, and occurrences synchronous to the user's system. Clock qualification is available with an external clock, and with an internal clock at speeds of 100 MHz or less.

Figure III-I

CLOCK SETUP SCREEN

```

©1988, Arrium Corporation                                ML4400
CLOCK Group A: LP4050 Oct 26, 1988 6:32pm
INTERNAL CLOCK ← Selected
  Clock period      : 0010 ns
  Clock rate        : 100 MHz
  Record time       : 81.9 µs

EXTERNAL CLOCK
  Master clock      : 1
  Slave clock       : (off)
  1-4: clock inputs ('+' means 'or')
  1-3: rising edge, 4: falling edge
  No. of slave bytes (0, 1 or 2) : 0
  Slave probe range :
  Clock qualifier valid : (Q1 & Q2)+(Q1 & Q2)
  (Enter 0, 1 or X)   : X X X X

TIMESTAMP
  Clock period (50 ns - 10 ms) : 0050 ns
  Clock rate                    : 20.0 MHz

100 MHz  50 MHz  25 MHz  INTERNAL  EXTERNAL  ROLL
CLOCK    CLOCK    CLOCK   CLOCK    CLOCK    TIMEBASE
  
```

1. CLOCK SOURCE

To select the clock source, depress the INTERNAL CLOCK or EXTERNAL CLOCK softkey; the default depends upon the type of Pod in use. The current clock source is denoted by the display of "<- Selected" just to the right of "INTERNAL CLOCK" or "EXTERNAL CLOCK".

2. CLOCK RATES

The maximum clock rates for the ML4400 vary between 25 and 400 MHz, depending upon the type of Pod in use, as shown in Figure III-J, below.

Figure III-J

MAXIMUM CLOCK RATES

| Pod | Internal | External |
|-----------------------------------|----------|----------|
| LP-4400 (with HS-4400) | 400 MHz | 100 MHz |
| LP-8200 (with HS-4400) | 200 MHz | 100 MHz |
| LP-4050 (with SC-4400) | 100 MHz | 25 MHz |
| LP-8025 (with LP-4050) | 100 MHz | 25 MHz |
| Microprocessor Pod (with SC-4400) | 100 MHz | 25 MHz |

3. INTERNAL CLOCK

a. Clock Period

The range of internal clock periods is 10 nsec to 200 msec.

To set the internal clock period, cursor to the "Clock period" field and enter a decimal value; then select the time base unit (ns, us, or ms) by depressing the ROLL TIMEBASE softkey until the desired unit is displayed. Not every frequency is available; when an unavailable selection is made, the closest available clock frequency is used. The ML4400 will then automatically update the "Clock rate" and "Record time" fields.

In certain Pod modes, only one frequency is available (e.g., only 10 ns may be selected for the LP-4050 in 100-MHz mode). For logic pods, the Pod mode may be changed in the Format Display screen by depressing the appropriate softkey

b. Clock Qualifier (HS-4400 configuration only)

The internal clock may be qualified by the Clock Qualifier probe when the ML4400 is operating at clock speeds of 100 MHz or less. The user may select "Low", which means that the clock is valid only when the qualifier input is low; "High", meaning it is valid only when the input is high; and "Always", meaning it is always valid. An internal clock is recognized only with a valid qualifier.

To select the internal clock qualifier, cursor to the "Clock Qualifier" field and depress 0 (Low), 1 (High), or 2 (Always) on the keypad.

4. EXTERNAL CLOCK

a. SC-4400 Configuration

(1) Clock Source (with LP-4050 or LP4050/LP-8025 only)

An external clock source is fixed for the Microprocessor Pods, but is settable by the user when using the LP-4050 and LP-8025 Pods. There are four clock inputs: Inputs 1-3 clock on the rising edge (low-to-high transition), and Input 4 clocks on the falling (high-to-low transition).

To set the external clock source, cursor to the "Master clock" field and enter the clock input (1, 2, 3, or 4). Depressing this key once includes the input; depressing it again excludes the input. Multiple-clock sources in a field are OR'd together; i.e., an occurrence of any of the clock's inputs will cause a clock.

For applications in which the data to be recorded is available at different times during a cycle (e.g., a processor with multiplexed address and data lines), use the "Slave clock" field. (The "Master clock" field defines the beginning phase of a cycle; the "Slave clock" field defines the last phase.)

All data except slave bytes is stored at the Master Clock time. Slave byte data is stored by the Slave Clock, but in the same trace cycle as the data from the previous Master Clock. For example: To record cycles from an 8085 (without an 8085 Microprocessor Pod), connect Clock Inputs 1, 2 and 3 to RD*, WR* and INTA*, and Clock Input 4 to ALE. Set the "Master clock" and "Slave clock" fields as follows:

| | |
|--------------|-------|
| Master clock | 4 |
| Slave clock | 1+2+3 |

Specify one slave byte, and connect the probes of that byte (32-39) to A7-A0.

(2) Slave Bytes

"Slave bytes" refer to the probes controlled by the Slave Clock. These bytes are clocked into the Trace Buffer when the Slave Clock occurs. To set the number of slave bytes, cursor to the "No. of slave bytes" field and enter the desired number. When the cursor exits the field, the "Slave probe range" field will be automatically updated to show which probes are contained in the slave bytes.

For the LP-4050, the number of slave bytes available is 0, 1, or 2. With the addition of an LP-8025, 0, 1, 2, and 4 bytes are available. Following are the slave byte probe definitions for each selection:

| Bytes | LP-4050 Probes | LP-8025 Probes |
|-------|----------------|----------------|
| ----- | ----- | ----- |
| 1 | 32-39 | N. A. |
| 2 | 24-39 | N. A. |
| 4 | None | 0-31 |

(3) Clock Qualifier

The external clock may be qualified by the Clock Qualifier probe(s), and the Qualifier may be designated to be "Low", "High", or "Don't Care". "Low" means the Clock Qualifier is valid only when the Qualifier input is low; "High" means it is valid only when the input is high; and "Don't Care" means it is always valid. An external clock is recognized only with a valid Qualifier.

There are two Clock Qualifier inputs, and each may be set to Low, High, or Always. Four "Clock qualifier valid" fields allow all Boolean combinations of the two qualifiers. For example, to qualify only when the Qualifier inputs are both either low or high, set the qualifier fields to 1, 1, 0, and 0, respectively.

(4) TimeStamp Clock Period

The ML4400 has a 14-bit hardware counter available to measure the time between cycles; this time measurement is called "TimeStamping." Seven TimeStamp periods are available, and any other values entered will be automatically rounded down. Clock rates for each of the valid TimeStamp periods are as shown below:

| TimeStamp Period | Clock Rate |
|---------------------|---------------|
| ----- | ----- |
| 50 ns | 20 Mhz |
| 100 ns | 10 MHz |
| 1 us | 1 MHz |
| 10 us | 100 KHz |
| 100 us | 10 KHz |
| 1 ms | 1 KHz |
| 10 ms | 100 Hz |

To enter a TimeStamp period, cursor to the TimeStamp "Clock period" field, use the keypad to enter the desired decimal value, then select the time base unit via ROLL TIMEBASE (which alternates from ns to us to ms, then back to ns).

b. HS-4400 Configuration

(1) Clock Qualifier

The external clock may be qualified by the Clock Qualifier probe when the ML4400 is operating at clock speeds of 100 MHz or less. The user may select "Low", which means that the clock is valid only when the qualifier input is low; "High", meaning it is valid only when the input is high; and "Always", meaning it is always valid. An external clock is recognized only with a valid qualifier.

To select the internal clock qualifier, cursor to the "Clock qualifier valid" field and depress 0 (Low), 1 (High), or 2 (Always) on the keypad.

(2) Clock Edge

The clock edge is the edge at which data is to be sampled. "Falling" means that the data is sampled on the high-to-low transition of the external clock input (as it crosses the threshold voltage), and "rising" means that it is sampled on the low-to-high transition.

To set the external clock edge, cursor to the "Clock edge" field and depress either 0 (falling) or 1 (rising) on the keypad.

G. TRACE CONTROL SETUP SCREEN (via TRACE key)

To access the Trace Control Setup screen, depress the TRACE key. There is one softkey, EDIT FIELD. This screen is used to select and edit the trigger delay and data qualification parameters.

Figure III-K

TRACE CONTROL SETUP SCREEN

| | | |
|--|---|-------------------------------------|
| ©1988, Arrium Corporation | | ML4400 |
| TRACE CONTROL | | Group A: LP4050 Oct 26, 1988 6:30pm |
| TRACE DELAY | | |
| Tracing will stop 04095 clocks after delay begins. | | |
| Tracing will begin up to 04094 clocks before delay begins. | | |
| DATA QUALIFICATION | | |
| Type (0=off, 1=comb, 2=state) | : | state |
| COMBINATIONAL QUALIFICATION | | |
| Trace (0=only, 1=all but) | : | only |
| Occurrences of | : | none |
| STATE QUALIFICATION | | |
| Begin with tracing | : | disabled |
| (0=disabled, 1=enabled) | | |
| Disable tracing on occur. of: | : | A |
| Enable tracing on occur. of: | : | A+B |
| (Type A-B to include/not/exclude a trigger word) | | |
| EDIT FIELD | | |

1. TRACE DELAY

The trace delay is the number of clock cycles after the trigger event at which data recording will stop; the delay will begin when the trigger occurs. The default trace delay is one-half of the Trace Buffer depth; the maximum allowable trace delay is 65,535 clocks.

To specify the trace delay, cursor to the "Tracing will stop" field and enter the desired number of clocks.

This trigger may be the same group, or the trigger from a different group, as is specified by the user on the Trigger Sequence screen (accessed via SEQ). For example: Group A is connected to a Microprocessor Pod, and Group B, to a 400-MHz Logic Pod. To stop recording in both groups when a specific instruction is executed by the microprocessor, set the trace delay for both groups to "A". The traces of the two groups are then time-aligned.

2. DATA QUALIFICATION (SC-4400 configuration only)

Data qualification allows only certain desired cycles to be recorded, allowing determination on an individual (combinational) or sequential (state) basis as to whether or not any given word (data sample) will be recorded. This dramatically conserves the Trace Buffer depth and makes problem areas more easily visible.

Note that data qualification does not affect recognition of trigger words, but does affect the trigger delay; i. e., a word included in the trigger sequence will be recognized regardless of whether or not data qualification allows it to be recorded, but only qualified words are counted in the trigger delay.

To select the data qualification type or to disable it, cursor to the "Type" field and use the keypad to enter 0 (off), 1 (combinational), or 2 (state).

(a) Combinational

To select a combinational data qualifier, cursor to the "Trace" field and use the keypad to enter 0 (only) or 1 (all but). Then cursor down to the "Occurrences of" field and specify the trigger word(s) upon which the selected qualifier will act by entering the appropriate label(s) (A-H). Depressing a key repeatedly will alternately include, "not", and exclude the trigger word from this field; the display places a bar over a trigger label to denote a "not".

For example, to record only nonzero data accesses at Address 010000H when using a Microprocessor Pod, specify the trigger words (in the Trigger Words as setup screen) follows:

| | ADDR | DATA | |
|----|--------|------|-------------------|
| C: | 010000 | XXXX | (Address 010000H) |
| D: | XXXXXX | 0000 | (Data = 0000) |

Then, in the Trace Control screen, set the "Type" field to 0 (comb), the "Trace" field to 0 (only), and the "Occurrences of" field to "C&D". This records any access at Address 010000H where the data value is not 0.

(b) State

To select a state data qualifier, cursor to the "Begin with tracing" field and use the keypad to enter 0 (disabled) or 1 (enabled). Then enter the trigger word label(s) (A-H) in the "Disable tracing on occur. of" field to specify the event which will disable recording. Next enter the trigger word label(s) in the "Enable tracing on occur. of" field to specify the event which will enable recording. Depressing a key repeatedly will alternately include, "not", and exclude the trigger word from this field, and the display places a bar over a trigger label to denote a "not".

For example: To record everything from a fetch at Address 030000H to a fetch at Address 030040H when using a Microprocessor Pod, set the trigger words as follows:

| | ADDR | STS | |
|----|--------|-------|-------------------|
| C: | 030000 | FETCH | (Address 030000H) |
| D: | 030040 | FETCH | (Address 030040H) |

Then set the "Begin with tracing" field to 0 (disabled), the "Disable tracing on occur. of" field to D, and the "Enable tracing on occur. of" field to C. This will turn on recording when 030000H is encountered, and turn off recording when 030040H is encountered.

H. TRIGGER WORDS SETUP SCREEN (via TRIG Key)

To access the Trigger Words Setup screen, depress the TRIG key. The available softkeys are ROLL STATUS (F2), STATUS BIT DEF'S (definitions) (F3), TEMP (temporary) BINARY (F4), RANGE (F5), and CLEAR WORD (F6); F1 is unused. (The F2 and F3 labels appear only when a Microprocessor Pod is being used.)

This screen is used to display and edit trigger words (events). The format (including size and display base) of trigger words is defined in the Format Display Setup screen. The trigger words are then combined (via the Trigger Sequence Setup screen) to define the trigger sequence. The number of trigger words available varies between 1 and 8, depending upon the ML4400 configuration and the type of installed Pod.

Figure III-L

AVAILABLE TRIGGER WORDS

| Pod | Operating Speed | | | | |
|---------|-----------------|---------|---------|-----------|---------|
| | 400 MHz | 200 MHz | 100 MHz | 25-50 MHz | <25 MHz |
| LP-4400 | 1 (A) | --- | 4 (A-D) | 4 (A-D) | 4 (A-D) |
| LP-8200 | --- | 2 (A-B) | 4 (A-D) | 4 (A-D) | 4 (A-D) |
| LP-4050 | --- | --- | 2 (A-B) | 4 (A-D) | 8 (A-H) |
| Micro. | --- | --- | --- | 8 (A-H) | 8 (A-H) |

Figure III-M

TRIGGER WORDS SETUP SCREEN
(WITH STATUS BITS WINDOW)

©1988, Arium Corporation
 ML4400

TRIGGER WORDS
 Group A: 8085 Oct 28, 1988 8:56am

| | EXT | STS | ADR | DAT |
|----|------|------|--------|---------|
| A: | XXXX | X011 | FETCH | 004E XX |
| B: | XXXX | X010 | MEM RD | 004F XX |
| C: | XXXX | X010 | MEM RD | 0050 XX |
| D: | XXXX | X011 | FETCH | 0100 XX |

E: STATUS BITS:

| | B2 | B1 | B0 | | B2 | B1 | B0 | |
|------------------|----|----|----|--------|----|----|----|--------|
| F: B3: prev HLDA | 0 | 0 | 0 | memory | 1 | 0 | 0 | undef |
| B2: IO/M* | 0 | 0 | 1 | mem wr | 1 | 0 | 1 | I/O wr |
| G: B1: SI | 0 | 1 | 0 | mem rd | 1 | 1 | 0 | I/O rd |
| H: B0: SO | 0 | 1 | 1 | fetch | 1 | 1 | 1 | LOCK |

Sequence: A then B then C then D

ROLL

STATUS

STATUS

BIT DEF'S

TEMP

BINARY

RANGE

CLEAR

WORD

1. TRIGGER WORDS

The trigger words are labeled A-H. Each trigger word field is defined (in the "STATE" section of the Format Display Setup screen) by the State field name, the number base (hexadecimal, decimal, octal, binary, or ASCII), high and low probe numbers, and data sense (inverted or noninverted).

On the Trigger Words Setup screen, the trigger word fields are displayed in the same left-to-right order in which they were defined in the Format Display Setup screen. Fields which have been turned off are not displayed. All numbers are displayed with their least-significant digit at the right; e. g., in a binary field of Probes 3-0, Probe 0 is at the right.

As a convenience to the user, the current trigger sequence (as defined on the Trigger Sequence or User Sequence Setup screen) is displayed at the bottom, just above the softkey labels.

Any trigger word (including those probes referring to external leads when a Microprocessor Pod is being used) may be used for data qualification, via the Trace Control Setup screen. This selective recording dramatically increases the effective Trace Buffer depth, and simplifies troubleshooting where only certain addresses or sections of code are failing.

To define a trigger word, cursor to each of its fields and use the keypad to enter the desired values. In addition to the 0-9 and A-F characters, a "Don't Care" (matches anything) may be entered via the X key, and an entire trigger word may be set to "Don't Cares" via the CLEAR WORD softkey. An entered digit that is too large for the selected number base will be rejected and a warning beep will sound. The upper bits of a too-large value will be truncated; e.g., if decimal 18 is entered in a 4-bit field, then the value will be truncated to, and displayed as, 2.

If all bits of a digit are entered as "Don't Cares", then the digit is displayed as "X"; if some of the bits are "Don't Cares", then it is displayed as "?". (This typically occurs when a field is edited in binary, and the number bases is changed later.)

In a decimal field, entering a "Don't Care" (X) will change the entire field to "Don't Cares", because there is not an integral number of bits per digit in decimal base.

The last calculator result ("Z") can be directly transferred to a trigger word field; see Section IV-G.1, "Calculator".

2. STATUS BIT DEFINITION

When using a Microprocessor Pod, the ROLL STATUS and STATUS BIT DEF'S softkeys are available. To quickly select one of the common values of one status value, cursor to any trigger word field of the desired trigger word and depress ROLL STATUS until the desired value is displayed in the field. To display a summary of the definitions of each status bit, depress STATUS BIT DEF'S. To close the Status Bit Definition window, depress STATUS BIT DEF'S again.

3. CHANGING NUMBER BASE (TEMP BINARY softkey)

The number base is selected and changed via the Format Display Setup screen. To temporarily view or edit a trigger word field without leaving the Trigger Words Setup screen, depress the TEMP BINARY softkey. The binary number will then be displayed in a highlighted field immediately below the other field.

4. TRIGGER WORD RANGE (SC-4400 Configuration only)

A trigger word range may be specified when the ML4400 is configured with an SC-4400 (Standard Capture Module). A range may combine any two adjacent trigger words; the range is then referred to by the label of the first of the two trigger words. For example, combining Trigger Words D and E from the Trigger Word Range D. To define a trigger word range, cursor to any field in the first trigger word and depress the RANGE softkey. To undefine the range, depress RANGE again.

Trigger word ranges have some limitations. If the active group comprises more than one Capture Module, then only the fields completely contained in the module providing the clock source of the group are included in the range.

Fields thus excluded from a range do not participate in triggering. Also, when operating with a Microprocessor Pod, any field including both Probes 39 and 40 is excluded from the range.

I. TRIGGER SEQUENCE SETUP SCREEN

To access the Trigger Sequence Setup screen, depress the SEQ key. The available softkeys are EDIT SEQUENCE (F1), EDIT ARM/TRIG (F2), COPY TO USER SEQ (F5), and USER SEQUENCE (F6); F3 and F4 are unused. This screen is used to select from a list of up to 27 predefined trigger sequences, and to access the User Sequence Setup screen, where more complex triggering is available. The number of sequences available depends upon the Capture Module being used and its operating mode; see Figure III-O, below.

The trigger sequence defines the condition which will stop the recording of data after the selected trigger delay. If the delay is zero, recording stops immediately upon occurrence of the trigger condition. The number of available predefined sequences depends upon the ML4400 group's configuration; the display of sequences unavailable for the current group will be dimmed on the screen.

A trigger sequence condition is formed by various combinations or sequences of the selected trigger words (events). The predefined sequences use up to four trigger words (A-D) and five levels. The user-defined sequence can use up to 8 trigger words (labeled A-H), arranged in up to 14 levels, and accommodates other complexities. In the displayed sequences, the "+" symbol denotes "or". (Trigger words are defined via the Trigger Words Setup screen, in Sec. III-H.)

On the second line of this screen, the "Trigger on group" field specifies the source of the trigger event (the point labeled "Trigger" on data displays and the event that begins the "Trace Delay") for the current group. This defaults to the trigger sequence termination (trigger) for the current group. When this field is set to the current group, trace delay will begin when the current group trigger condition/sequence is met, and recording will subsequently stop. This field may be set to any group's trigger, or to an external trigger, or to any combination thereof.

A common use of this feature is cross-triggering: to set this field to another group's trigger (so Group A triggers when Group B's trigger sequence is satisfied.) In this case, the trigger sequence set in Group B will dictate the trigger for Groups A and B, and the resulting sets of captured data will have their trigger events time-aligned.

Only in the 80-channel and Slow 40 modes of operation are all 28 sequences (including the user-defined sequence) available, as shown in Figure III-O.

Figure III-N

TRIGGER SEQUENCE SETUP SCREEN
(WITH "EDIT SEQUENCE" ACTIVATED)

| | | | |
|--------------------------------------|---------|--------------------------------|---------------------|
| ©1988, Arrium Corporation | | ML4400 | |
| TRIGGER SEQUENCE | | Group A: 68000 | Jul 22, 1988 6:40pm |
| Arm seq on group: START | | Trigger on group: A+B | |
| (Groups: A=68000, B= 8085, X=extern) | | | |
| A+B then B then (A+B+G+H + disabled) | | | |
| 0: A | | E: A then (B without C) | |
| 1: (A+B) | | F: A then B then C then D | |
| 2: (A+B+C) | | G: A then B then (C without D) | |
| 3: (A+B+C+D) | | H: A then (B without C) then D | |
| 4: A then B | | I: (COUNT of A) | |
| 5: (A+B) then C | | J: (COUNT of A) then B | |
| 6: A then (B+C) | | K: A then (COUNT of B) | |
| 7: A then B then C | | L: ((COUNT of A) without B) | |
| 8: (A+B) then (C+D) | | M: (TIME without A) | |
| 9: (A+B+C) then D | | N: A then (B without TIME) | |
| A: A then (B+C+D) | | O: rising edge of probe n | |
| B: (A+B) then C then D | | P: falling edge of probe n | |
| C: A then (B+C) then D | | Q: glitch on probe n | |
| D: A then B then (C+D) | | | |
| END | TRIGGER | ROLL | |
| EDIT | +/x | ns/ms/sec | |

Figure III-O

AVAILABLE TRIGGER SEQUENCES

| Capture Module | Operating Mode | Available Trigger Sequences |
|-------------------|-------------------|--------------------------------|
| ----- | ----- | ----- |
| <u>HS-4400</u> | | |
| | 4 channels | 0, 1, 2, and 3 |
| | 8 channels | 0, 1, 2, and 3 |
| | 16 channels | 0, 1, and 4 |
| <u>SC-4400</u> | | |
| | 100-MHz | 0, 1, 4, and I-P |
| | 50-MHz | O-P |
| | 25-MHz | All (28) |
| ----- | ----- | ----- |

NOTE: Users of Arium's earlier ML4100 logic analyzer will find that the first 14 ML4400 trigger words are identical to the first 14 of the ML4100, including the alphanumeric designations (0-D) by which they are selected. Four other sequences are identical except for their designations:

Figure III-P

TRIGGER SEQUENCES DIFFERENCES
(ML4100 AND ML4400)

| Sequence | Designation | |
|-----------------------------|-------------|--------|
| | ML4100 | ML4400 |
| ----- | ----- | ----- |
| A then B then C then D | E | F |
| A then (B without C) | F | E |
| A then B then (C without D) | f1 | G |
| A then (B without C) then D | f3 | H |
| ----- | ----- | ----- |

1. PREDEFINED TRIGGER SEQUENCES

a. Selecting a Sequence

To select a predefined trigger sequence, and enter the sequence's alphanumeric designation (0-Q). The selected sequence will appear on the fourth line of the screen. The default sequence is selection "0", predefined as Trigger Word A.

The other selections include combinations or sequences of trigger words to make up the trigger condition. For example, the sequence designated "7" ("A then B then C") will cause recording to continue until Trigger Word A is encountered, then until Trigger Word B is encountered, then until Trigger Word C is encountered. At this point, the entire trigger condition has been satisfied, and the delay will begin. (Recording will stop immediately if the delay is zero.)

Sequence G ["A then B then (C without D)"] is identical to Sequence 7, except that, if "D" is encountered after "B" but before "C", then the ML4400 will begin again to search for "A". This sequence can be very useful when it is desired to trigger only when one event occurs immediately after another. To do this, use a sequence such as the G sequence, with "D" containing all "Don't Cares"; in this case, "B" and "C" will have to occur with no other cycles in between to satisfy the trigger condition.

b. Copying a Predefined Sequence to User Sequence Screen

To copy any predefined sequence to the User Sequence setup screen, depress the COPY -> USR SEQ softkey.

c. Editing a Predefined Sequence

When editing a sequence, the softkeys change to END EDIT (F1), TOGGLE +/& (F2), and ROLL NS/MS/SEC (F3).

To edit a predefined trigger sequence, first select the sequence (0-Q), then depress the EDIT SEQUENCE softkey. This causes the sequence field (on the fourth line) to be highlighted, and divided into separate fields for each element, allowing cursor movement between them.

To edit a trigger word in the sequence, cursor to its field and use the keypad to enter the desired trigger word (A-H) or toggle it between include, "not", and exclude. (The display will place a bar over a word to denote "not".) To toggle operators of a field between the logical OR ("+") and logical AND ("&"), operators, depress the TOGGLE +/% softkey.

To specify a counter value ("COUNT") or timer value ("TIME"), cursor to the COUNT or TIME element field and enter the desired value. To change the timer time base while in a TIME field, depress ROLL US/MS/SEC until the desired time base is displayed.

To exit the edit mode, depress the END EDIT softkey.

d. Arm Condition for Trigger Sequence

The arm condition determines when the selected trigger sequence becomes active (is armed). It may be set at START, at an external trigger event, or (in multigroup applications) at another group's satisfaction of its trigger sequence.

The current arm condition is displayed in the "Arm Sequence on Group:" field on the second line of both the Trigger Sequence and the User Sequence Setup screens. This field is accessed via the Up Arrow key.

In most single-group applications, the arm condition is set to "START"; i. e., the sequence becomes active when START is depressed. To select an external source as the arm condition, enter X. To reset the arm condition to "START", depress CLEAR.

For multigroup applications, to select another group's trigger sequence as the arm condition, enter the group label (A-D).

A logical OR combination of groups and the external trigger input is allowed, and is designated by "+" in the "Arm seq on group" field.

e. Cross-Triggering Condition

The "Trigger on group:" field specifies what event will trigger the current group. This field is most often used to time-align the Trace Buffers of two different groups when cross-triggering in multigroup applications.

The current trigger event is displayed in the "Trigger on group:" field on the second line of both the Trigger Sequence and User Sequence Setup screens. This field is accessed via the cursor keys (Arrow keys).

For most single-group applications, the field is set to the current group label (A-D), showing that a trigger will occur when the trigger sequence is satisfied. To instead trigger on an external source, enter X.

For cross-triggering in multigroup applications, to specify another group's trigger event, enter the group label (A-D). For example, Group A's Trigger field is set to B and Group B's Trigger field is set to B. To start both groups simultaneously, depress 2ND, START. Both groups will trigger when Group B's trigger sequence is satisfied; note that the Group A trigger sequence is ignored. To then display both groups' trace buffers, use the SPLIT key (see Section IV-D.5).

A logical OR combination of groups and the external trigger input is allowed, and is designated by "+" in the "Trigger on group" field. For example, Group A's Trigger field is set to A+B+X. Group A triggers (and begins counting out its delay) when either its own trigger sequence is satisfied, when Group B triggers, or when the external trigger input goes active.

2. USER-DEFINED SEQUENCE

To access the User Sequence Setup screen, depress the USER SEQUENCE softkey while in the Trigger Sequence setup screen. The following softkeys are available (from left to right): EDIT FIELD, ADD LEVEL, REMOVE LEVEL, ADD FUNCTION, REMOVE FUNCTION, and RETURN TO MENU.

To return to the Trigger Sequence setup screen (the menu of predefined trigger sequences), depress RETURN TO MENU.

The User Sequence Setup screen allows the user to define a highly complex trigger sequence, providing complete control over triggering capabilities. Rather than selecting a predefined sequence (in the Trigger Sequence setup screen), the user can build up virtually any desired sequence. The user may find it convenient to use a predefined trigger sequence (copied from the Trigger Sequence screen via the COPY -> USER SEQ softkey) as the initial building block.

Depending upon the ML4400 group configuration, a user-defined trigger sequence can have up to 8 trigger words, up to 14 sequence levels, data qualification, mixtures of logical OR ("+") and logical AND("&") in the same field, and the ability to GoTo any level in a sequence.

Figure III-Q

USER SEQUENCE SETUP SCREEN

| ©1988, Arrium Corporation | | | ML4400 | |
|--|--|-------------|---------------------|---------------------|
| USER SEQUENCE | | | Group B: 8085 | Jul 22, 1988 6:52pm |
| Arm seq on group: A | | | Trigger on group: B | |
| (Groups: A=68000, B= 8085, X=extern) | | | | |
| Level | Do function: | Occurrence: | FUNCTIONS | |
| 1 | TRACE OFF ADVANCE LEVEL on 00001 of A | | 1. Trigger | |
| 2 | TRACE ON ADVANCE LEVEL on 00003 of C+D GOTO LEVEL 01 on 00001 of A&C | | 2. Advance level | |
| 3 | ADVANCE LEVEL on 00050 μs | | 3. Goto level | |
| 4 | GOTO LEVEL 01 on 00001 of A&D TRIGGER on 00001 of D | | 4. Trace only | |
| | | | 5. Trace all but | |
| | | | 6. Trace on | |
| | | | 7. Trace off | |
| | | | 8. Disable trace | |
| | | | 9. Enable trace | |
| | | | A. Pad func on | |
| | | | B. Pad func off | |
| | | | OCCURRENCES | |
| | | | A. Count of | |
| | | | B. Time (μs-sec) | |
| <div> <div>EDIT FIELD</div> <div>ADD LEVEL</div> <div>REMOVE LEVEL</div> <div>ADD FUNCTION</div> <div>REMOVE FUNCTION</div> <div>RETURN TO MENU</div> </div> | | | | |

a. Sequence Levels and Functions

The 14 sequence levels are numbered (vertically) on the left side of the screen. All of the levels in the sequence need not fit on a single screen; the display scrolls to accommodate long sequences.

Sequence levels are composed of sequence functions. There are 11 available functions, listed on the right side of the screen and designated 1-B. Not all functions are available in all configurations; when the ML4400 is configured with a HS-4400, only Functions 1-3 are available. Sequence functions are described in Figure III-R, below.

Figure III-R

TRIGGER SEQUENCE FUNCTIONS

| Function | Description |
|--|--|
| <u>[Functions 1-3 are available with all configurations:]</u> | |
| 1. Trigger | End the sequence and begin counting out the trigger delay. |
| 2. Advance level | Advance to the next sequence level when the trigger word condition is satisfied. |
| 3. GoTo level | Jump to the specified sequence level when the trigger word condition is satisfied. |
| <u>[Functions 4-B are available only with SC-4400 configurations:]</u> | |
| 4. Trace only | Record only instances of the specified trigger word condition (combinational data qualification) (at this level). |
| 5. Trace all but | Record all but instances of the specified trigger word condition (combinational data qualification) (at this level). |
| 6. Trace on | Begin this level with recording enabled (state data qualification). |
| 7. Trace off | Begin this level with recording disabled (state data qualification). |
| 8. Disable trace | Disable recording on the specified trigger word condition (state data qualification). |
| 9. Enable trace | Enable rerecording on the specified trigger word condition (state data qualification). |
| A. Pod func. on | Pod-specific. |
| B. Pod func. off | Pod-specific. |

No more than a total of 42 functions may be used in a sequence, but these functions may be mixed with levels in any combination. E. g., a sequence may have 14 levels with 3 functions per level, or 7 levels with 6 functions per level.

To add a sequence level, cursor to the level after which the new level is to be added and depress the ADD LEVEL softkey. To remove a sequence level, cursor anywhere within the level to be removed and depress the REMOVE LEVEL softkey (and a window will prompt the user to verify the operation); depress REMOVE LEVEL again.

When sequence levels are added or removed, the level numbers of GoTo functions are automatically updated. (A warning is issued if the removed level was referenced by a GoTo function.)

To add a sequence function, cursor to the function after which the new function is to be added and depress ADD FUNCTION. To remove a sequence function, cursor anywhere within the function to be removed and depress the REMOVE FUNCTION softkey. (If the function is the only function at that level, then the level itself is removed.)

b. GoTo Levels

To jump to a level when the specified trigger word condition is satisfied, enter the sequence level (01-14). (GoTo level numbers are automatically updated when sequence levels are added and removed.)

c. Timer (SC-4400 configuration only) and Counter

When the ML4400 is configured with an HS-4400, a counter may be used; when configured with an SC-4400, both a counter and timer may be used.

To select a counter field, depress A; to select a timer field or to roll the time base units of an existing timer, depress B. To enter a (decimal) value (0-66535), use the keypad. (Only one timer is allowed per user-defined sequence.)

d. Editing Trigger Word Fields

To edit a trigger word field, depress the Trigger Word alphanumeric designation to alternately include, "not", or exclude it. To clear a trigger word field, depress CLEAR. Logical OR and AND are represented by "+" and "&", respectively.

To further edit a trigger word field, depress the EDIT FIELD softkey, and use the arrow keys to position the cursor in the field. Then use the keypad

to enter trigger word letters, and the softkeys to enter OR and AND. To clear a trigger word field, depress CLEAR.

To end the edit mode, depress END EDIT.

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