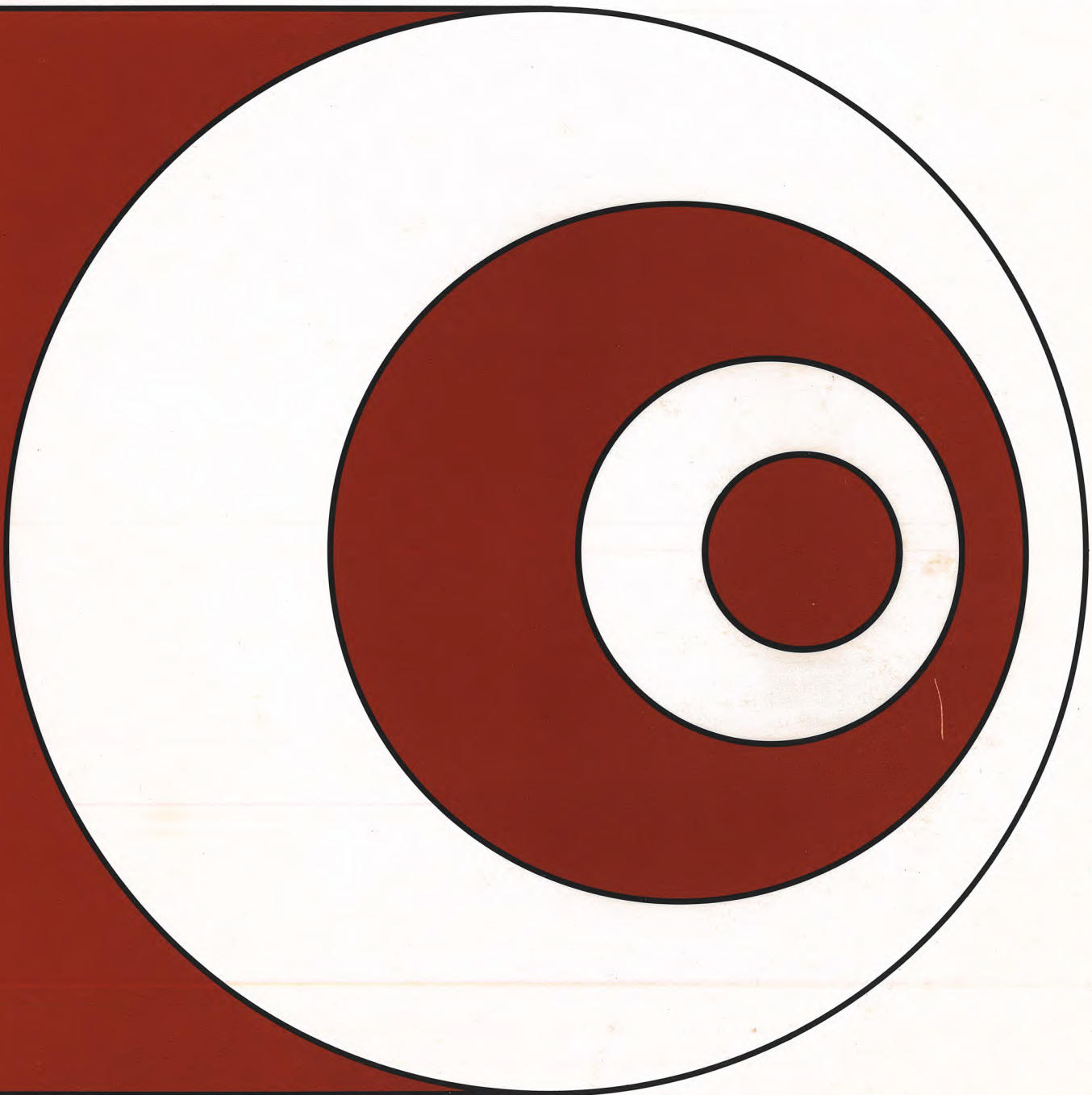


**SIGNETICS TWIN
REAL TIME
HARDWARE ANALYZER
SUPPLEMENT TO OPERATOR'S GUIDE**



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1.0 REAL-TIME HARDWARE ANALYZER PRODUCT OVERVIEW

The Hardware Analyzer (HWA) provides the designer with a tool to monitor the user's system operation in real-time (through the TWICE cable) and detect faulty hardware or software logic. It also allows memory space to be mapped into segments, each of which may reside either internal to the TWIN (common memory) or within the user's prototype hardware (user memory).

1.1 PURPOSE

The basic TWIN hardware/software package is capable of supporting the early stages of prototype development in various "Debug" modes. It does not allow the user to monitor the system in real-time, because the slave unit is halted whenever its status is checked or displayed. This product is designed to support a prototype system development effort to the very end, where that system operates in a real-time environment.

1.2 TWIN SYSTEM WITH HWA

The HWA consists of an additional hardware/software package to the basic TWIN system which consists of a single circuit board, and several supporting command overlays in the operating system (SDOS version 3.1 and up).

1.3 FEATURES

1. Real-time Trace of 256 bus transactions (address, data, and control).
2. 256 bytes of Shadow Memory (RAM) for utility programs.
3. Memory mapping, 64K bytes in 128 byte blocks.
4. Real-time breakpoint.

1.4 TYPICAL APPLICATIONS

1. Monitor user program flow in real-time during prototype system development.
2. Perform product acceptance tests in production environment
3. Trouble shoot, field service faulty hardware logic, such as bad memory chips, I/O ports etc.

1.5 JUMPERS

On slave card version TW90012061 JE-A the following jumper changes should be made if hardware analyzer is to be used.

REMOVE JUMPER 1 - 2
REMOVE JUMPER 17 - 18
ADD JUMPER 2 - 3
ADD JUMPER 18 - 19

If slave card TW90012061 JE is used then PCB must be modified as instructed in the hardware analyzer reference manual page 6.

2.0 USER REQUIREMENTS

There are several SDOS commands with which the user should be familiar to fully utilize the HWA capabilities. Section 3 of this manual explains the formats and parameters of the individual commands. The following commands are available:

ICE - Turn ICE mode on/off
MAP - Map user or common memory
RTT - Arm Real-Time Trace
DRT - Dump Real-Time Trace
MOVE - Move a memory block to another location
READ - Read user memory, data or I/O port
WRITE- Write user memory, data or I/O port

2.1 A TYPICAL PROCEDURE

1. Turn ICE mode on.
2. Map memory to the user in the desired address range.
3. Move program code from common memory to user memory (if not already resident).
4. Arm Real-Time-Trace.
5. Execute program.
6. Dump Real-Time Trace.

2.2 I/O CAPABILITY

The TWICE cable provides the necessary connection between the TWIN and the user's system.

2.3 USER PROBES

Pins 3, 4, 5, 6, 7 of the 16 pin socket (located on the upper right-hand corner of the PC board) provide the connection capability to user probes 0,1,2,3,4 and pin 2 to user probe 5, respectively.

Their displayed status follows the rules of "negative logic" (LOW=1)

3.0 RTA SOFTWARE COMMANDS

This section describes those SDOS commands intended for use in conjunction with the Real-Time Analyzer option. They are present in SDOS versions 3.1 and higher:

ICE	Turn ICE mode on and off
MAP	Map user on common memory
RTT	Arm Real-Time Trace
DRT	Display Real-Time Trace
MOVE	Move a memory block to a new location
READ	Read user memory, data, or I/O port
WRITE	Write user memory, data, or I/O port

NOTE:

The READ and WRITE commands are described on pages 4-49 and 4-51, respectively, of the TWIN Operator's Guide.

3.1 ICE

<u>ICE</u> [mode]

PURPOSE

The ICE command is used to specify slave CPU operational mode.

EXPLANATION

THE ICE command mode sets the slave CPU mode of operation. The possible values for MODE are:

- OFF - Puts the slave in normal mode, using TWIN slave memory, I/O, and and clock.
- ON - Puts the slave in TWICE mode with mapped memory (See "MAP" command), user prototype I/O and clock.

The default is OFF.

NOTE:

If no hardware analyzer is present in the system, the form of the ICE command is slightly different. Refer to the TWIN Operator's Guide.

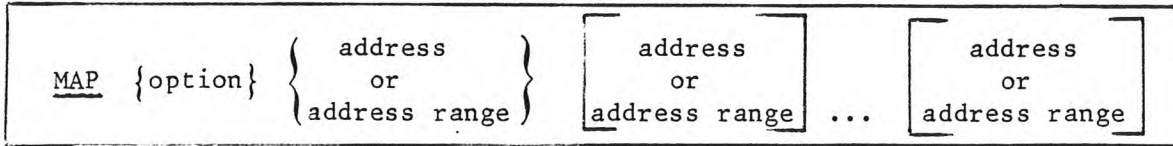
ICE Error Responses

- 32 - Too many parameters
- 54 - Invalid mode

CAUTION

The ICE Command replaces the SLAVE command of SODS Version 2.0.

3.2.1 MAP (Parameter Assignment Form)



PURPOSE

The MAP command is used to set user memory assignments for use in ICE mode ON. When ICE mode is ON, the user may specify for a full 64K bytes of memory, in blocks of 128 bytes, which memory, TWIN common or user prototype, will be accessed by the user program instructions which access memory locations. The map also applies to slave memory references made by the functions DUMP, PATCH, EXAMINE, and DEBUG. Any blocks not specified in the command stream retain their prior assignments.

Neither the mapping function nor slave memory are initialized at power-on or RESET time. However, the user may easily create a command file to initialize these values should he so desire.

EXPLANATION

Option

A single character specifying the type of memory which is to be accessed in the range specified by the address parameter.

U = User Prototype Memory

C = TWIN Common Memory

(no default)

Address

A one to four digit hexadecimal number in the range 0000 to FFFF

Address Range

Two hexadecimal numbers (one to four digits each) separated by a hyphen (-). The first hexadecimal number (start value) must be smaller in value than the second hexadecimal number (stop value).

USAGE NOTES

1. The maximum length of the command stream is 79 characters. Any number of addresses (or address ranges) up to that number of characters may be entered at once.
2. All addresses must be entered as hex numbers.
3. If the start address of a range or a single block is not 0 modulo 128, it will be justified down to the nearest block boundary.

4. If the stop address of a range is not 127 modulo 128, it will be adjusted upward to be so.
5. If a range is given, start and stop addresses should be separated with a hyphen (-).
6. A combination of single addresses and address ranges may be entered in the same command line.
7. If an input error is detected in any parameter, none of the command line is processed.

EXAMPLE

```
> MAP U 100-1FF
```

This specifies that, in ICE mode "ON", all memory references to locations 100 through 1FF will operate on user prototype memory. Accesses to locations 0000-00FF and 0200-FFFF will be accessed as specified by previous "MAP" commands.

3.2.2 MAP (Status Display Form)

MAP [option] [output]

PURPOSE

To display the current status of memory access assignments as specified by previous "MAP" commands in the parameter assignments form.

EXPLANATION

Option

This is an optional parameter which specifies the display format:

G = Graphic display

R = Address ranges in hex

Default = R

Output

This is an optional parameter specifying the device name to which the display is to be routed

Default = CONO

USAGE NOTES

1. The parameters must be entered in the order shown.
2. If OPTION is left out, it must be placeheld in the command with commas.
For example:

> MAP,,LPT1

will route the display in range format to the line printer.

3. OUTPUT may be any valid device or file. However, if a filename is given which already exists, the old file will be overwritten with the new display map data.
4. Entering MAP with no parameters will produce a range display on CONO.

EXAMPLE DISPLAY FORMATS

1. The range format lists in hex the address ranges of TWIN common and user prototype memory for all 64K of memory. For example, the command:

```
> MAP R LPT1
```

results in the mapping assignments being printed on the line printer in the format shown in Figure 1.

```
0000-07FF=U
0800-6FFF=C
7000-707F=U
7080-78FF=C
7900-7FFF=U
8000-FFFF=C
```

FIGURE 1

"MAP" RANGE DISPLAY FORMAT

2. The graphic display portrays each block assignment separately in table form. A "-" denotes common memory and a "U" denotes user prototype memory. This choice of flags enables the user to readily see which blocks are assigned to his prototype system memory. Figure 2 shows the result of the command:

```
> MAP G LPT1
```

with the same mapping assignments as are active in Figure 1.

EXIT

Upon normal completion of the command, the completion message

```
*MAP* EOJ
```

will be printed on CONO and the SDOS prompt character, '>', is issued. To abort MAP, hit the ESCAPE key. The completion message and SDOS prompt are issued as described above. Only the display option can be aborted.

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0X00	UU	UU	UU	UU	UU	UU	UU	UU	--	--	--	--	--	--	--	--
1X00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2X00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
3X00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
4X00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
5X00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
6X00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
7X00	U-	--	--	--	--	--	--	--	--	UU	UU	UU	UU	UU	UU	UU
8X00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
9X00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
AX00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BX00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CX00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
DX00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
EX00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
FX00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

FIGURE 2

"MAP" GRAPHIC DISPLAY FORMAT

ERROR RESPONSES

- 7 - DEVICE WRITE ERROR
- 10 - OVERLAY LOAD FAILURE
- 15 - INVALID OUTPUT DEVICE
- 17 - OUTPUT DEVICE ASSIGN FAILURE
- 30 - INVALID PARAMETER (option is not C,U,G, or R)
- 31 - ADDRESS OR RANGE PARAMETER REQUIRED
- 39 - INVALID HEX
- 43 - INVALID DATA PARAMETER, wrong format for address or start value is greater than stop value
- 67 - NO HARDWARE ANALYZER CARD

3.3 RTT - REAL TIME TRACE

<u>RTT</u> [Option] [Address] [Count]

PURPOSE

The Real-Time Trace command, RTT, is used to "arm" and "disarm" the real-time trace feature of the hardware analyzer card. When armed, the trace buffer memory stores the state of the slave processor address, data, and control lines during each bus cycle user of program execution. This process continues until either emulation is ceased (by the operator hitting the ESC key) or a specified "trigger" condition is encountered. The contents of the trace buffer may then be examined via the "DRT" (Display Real-Time Trace) command to determine the sequence of events which led up to the occurrence of the trigger condition.

The trigger condition consists of an address match plus a count, both of which are specified as parameters in the RTT command. Alternatively, a logic 0 on user probe 5 substitutes for the address match portion of the trigger qualification.

EXPLANATION

Option

This optional parameter defines which types of bus cycles are to be stored in the trace buffer. It may be specified by one of the following values:

<u>OPTION</u>	<u>TRANSACTIONS</u>
F	Instruction Fetches Only
I	I/O Accesses Only
M	Memory Accesses Only
R	Read Operations Only
W	Write Operations Only
IR	I/O Reads Only
IW	I/O Writes Only.
MR	Memory Reads Only.
MW	Memory Writes Only
*	All Bus Transactions (Default)
OFF	Disarm Real-Time Trace

Address

This optional parameter may be any hexadecimal address in the range 0-FFFF. Entering a valid ADDRESS will arm the "stop on address-compare plus count". If ADDRESS is not entered, the "stop" feature will be disarmed and the final 256 instructions executed are stored. If ADDRESS is entered, OPTION must be entered or placeheld with 2 commas.

Count

This optional parameter may be entered only if ADDRESS is entered also. If ADDRESS is entered with no COUNT, the COUNT will default to 128.

USAGE NOTES

1. The Real-Time Trace, when armed, continually stores the requested transaction type in its circular buffer as a user program executes. If at least 256 transactions are stored, they will be the last 256 transactions which occurred before the job terminated.
2. The contents of the Real-Time Trace buffer may be displayed by using the "Display Real-Time Trace" command, DRT.
3. Note that the "stop" feature allows a snap-shot of transactions to be saved which describes real-time events before and after a given address is encountered.
4. Whether or not the "stop" feature is used, the user program continues its execution to completion. That is, the stop only stops storage of transactions in the Real-Time Trace buffer, not of user program execution.
5. If the Real-Time Trace is armed and the Debug trace is running simultaneously, the internal branch instructions for halting/restarting the slave during Debug trace will be stored in the Real-Time Trace buffer.

EXIT

The job completion or error message identification is

RTT EOJ or *RTT* ERROR nn

ERROR RESPONSES

- 30 Invalid Option
- 31 Parameter Required
- 34 Invalid Address
- 43 Invalid Count
- 67 No Hardware Analyzer Card
- 32 Too Many Parameters

3.4 DRT DISPLAY REAL-TIME TRACE

DRT [Device] [Filename] [/D] (Display Mode Form)

or

DRT {Filename/D} (Storage Mode Form)

PURPOSE

The DRT Command is used to display the contents of the Real-Time Trace (RTT) buffer. The information is displayed in an easily readable ASCII format as shown in figure 3. The display may be directed to a specified output device (not a file).

Alternatively, the RTT buffer contents may be transferred in binary RTT-buffer image format (saves disk space) onto a given disk file for storage. It may subsequently be displayed from the file to a non-file ASCII device.

EXPLANATION (Display Mode Form)

Device This optional parameter is a non-file ASCII output device.

(default = CONO)

Filename This optional parameter is the name of a disk file which contains an RTT image generated by the DRT command in the Storage Mode Form. (See explanation below of Storage Mode Form.)

(Default = use the current contents of the RTT Buffer.)

/D Is an optional parameter which may be used to specify the disc drive number on which the specified file resides.

(default = 0)

USAGE NOTES (Display Mode Form)

1. If Filename is given, the current contents of the RTT buffer and HWA database will be overwritten by the information from the file and then the display will proceed.
2. If Filename is not given, the display will reflect the current contents of the RTT buffer and the HWA database.

EXPLANATION (Storage Mode Form)

Filename/D This parameter specifies the filename and drive number to which the contents of the RTT buffer will be transferred.

USAGE NOTES (Storage Mode Form)

1. As a precautionary restriction, the drive number (/D) must be entered along with FILENAME.
2. Dumping to a file will not disturb the current RTT buffer contents or the related HWA database.

COUNT	()	LOC.	DATA	MNEM, REG	PROBES	BUS
+	0	023C	F9	BDRR, 01	00000	MRF
+	1	023D	76		00000	MR
+	2	0234	0F	LODA,03	00000	MRF
+	3	0235	B8		00000	MR
+	4	0236	F4		00000	MR
+	5	18F4	16		00000	MR
+	6	18F5	FO		00000	MR
+	7	16F2	4F		00000	MR
+	8	0237	EE	COMA, 02	00000	MRF
+	9	0238	22		00000	MR
+	10	0239	B1		00000	MR
+	11	0369	4F		00000	MR
+	12	023A	98	BCFR,00	00000	MRF
+	13	023B	5A		00000	MR
+	14	023C	F9	BDRR, 01	00000	MRF
+	15	023D	76		00000	MR
+	16	0234	0F	LODA,03	00000	MRF
+	17	0235	B8		00000	MR

FIGURE 3

EXAMPLE OF DRT DISPLAY FORMAT

DISPLAY DESCRIPTION (refer to figure 3)

- COUNT: Shows bus transaction number of stored data with respect to trigger point
- LOC: Address bus contents stored during bus transaction.
- DATA: Data bus contents stored during bus transaction.

MNEM, REG: Instruction mnemonic, dis-assembled from address, data, and control bus information.

PROBES: Logic states of the 5 external probes.

BUS: Type of bus cycle stored (decoded from control bus lines) in the following format:

MR	Memory Read
MRF	Instruction Fetch
MW	Memory Write
IR	Input/Output Read
IW	Input/Output Write

GENERAL USAGE NOTES

1. DRT file contents cannot be displayed if there is no hardware analyzer in the system.
2. DRT will not execute if the Debugger is active.
3. DRT will display only those transactions stored since the most recent program started with the real-time trace armed. If no data were stored, none will be displayed.
4. If an address match was expected (See the RTT command) but was not encountered, no memory display will occur, but "*DRT* Error 69" will be generated to inform the user.
5. If an address match was expected and did occur, but the user program terminated (halt, etc) before the entire "count" was achieved by the real-time trace, then the display will reflect the trace up to the termination point and an indicator will inform the user of the premature halt.
6. A program running on the slave CPU is temporarily paused while DRT is executing to avoid any conflicts due to the HWA memory access mode.

EXIT

The completion or error job identification for the command is:

DRT EOJ or *DRT* ERROR nn

Error Responses

- | | |
|----|--|
| 6 | Input file read error |
| 7 | Output device write error |
| 8 | Drive number required |
| 10 | Overlay part 2 load failure |
| 14 | Invalid input device (must be an old file) |
| 15 | Invalid output device |
| 16 | Input device assign failure |
| 17 | Output device assign failure |
| 69 | RTT "MATCH" expected, none occurred |

4.0 REFERENCES

Signetics TWIN Operator's Guide

Signetics TWIN Real-Time Hardware Analyzer Supplement to Reference Manual

Signetics TWIN Real-Time Hardware Analyzer Supplement to Maintenance Manual

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