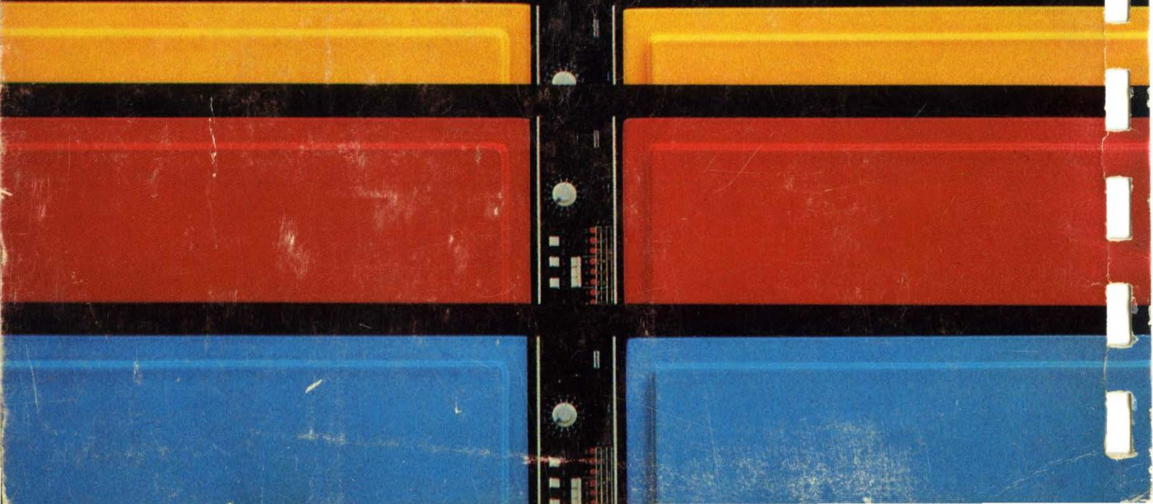
SENTRY V VII VIII

General Purpose LSI Test Systems Quick-Reference Handbook



Sentry® V, VII, VIII

Quick-Reference Handbook

Publication Number 575000-18

Notice

This handbook is a quick reference guide intended for use by programmer/operators of the SENTRY V, VII, and VIII test systems. The information provided is complete in terms of user interactions with system hardware and software but explanations are condensed to ease reader access to specific data. This handbook thus assumes prior training or knowledge of the more detailed explanations within the manuals listed below.

The information presented in this handbook may not contain important details or current software changes and is subject to change without notice.

Fairchild Test Systems Group makes no warranty of any kind with respect to the material contained in this handbook, including but not limited to any implied warranty of fitness for a particular purpose. FTSG is not liable for any errors or for incidental or consequential damage in connection with the furnishing or use of this handbook.

This handbook contains proprietary information. No part of this handbook may be photocopied, reproduced, or translated into another program language without the prior written consent of FTSG.

The applicability of information to specific user systems and software packages has not been noted. More specific information is found in the following:

Title	**Publication Number**
MASTR Command Language Reference Manual	57500005 (8/78)
MASTR Factor Programming Reference Manual	57500006 (6/78)
FST-2 Computer Manual	67095701 (2/77)

Contents

1 General Information

2 MASTR Command Language

3 MASTR Factor Programming Language

4 FST-2 Computer

Appendices

Tables

Figures

1 General Information

Software Description Key

UPPER CASE	= Required parameter, entered or displayed exactly as shown.
lower case	= Variable parameter, supply required information.
[X/Y/Z]	= Required parameter, must select, but only one.
(X)	= Optional parameter, select or not.
(X/Y/Z)	= Optional parameter, select or not, but only one.
X/Y/Z	= Underline indicates default, if no parameter selected.

Loading MASTR Software

The following procedure loads MASTR software into memory from a memory backup (MBUP) tape (SENTRY V) or onto disk from a disk backup (DBUP) tape (SENTRY VII, VIII).

1. **At the tape unit:**
   a) Mount the tape containing MASTR operating system.
   b) Press LOAD to advance tape to beginning of tape (BOT).
   c) Press ON-LINE to place tape on-line.

2. **On the FST-2 Control Panel:**
   a) Set switch register to 01000100.
   b) Press STOP, RST, LDP, LDC, LDMT and RST pushbuttons in that order.
   c) Press START to start reading tape.

3A. Sentry V only:

1. When memory load is completed the following question is displayed on the video keyboard terminal (VKT):

   MBUP OF MASTR—PERFORM RESET?

   a) Type: Y (to initialize all globals and clear memory and I/O usage).
   b) Type: N (to restore system status at time tape was generated: keep globals as they were and load files that were in memory.

2. To run tester diagnostics proceed as follows:
   a) Type: LOAD 'DL' 'RUN' 'LOADIT' MTRn (where n = tape unit number 1 or 2)
   b) Type: RUN 'LOADIT'
   c) Enter station number to output diagnostic menu.

3B. Sentry VII and VIII only:

1. After the tape header is displayed and the files are loaded onto disk the DOPSY prompt will appear.
   a) Type: MASTR (to restore system status).
   b) Type: MASTR CLEAR (to initialize system).

4. Remove tape from unit
   or take off-line to prevent accidental writing.

Loading MASTR Overlays

On Senty V, overlays that are not present must be loaded into memory from tape. To load files from tape, type:

LOAD 'overlay-name' MTRn (where n = tape unit number 1 or 2)

On Sentry VII and VIII, overlays are already resident on disk.

Error Recovery

If terminal control is lost, try Phase 1 first, then Phase 2, and finally Phase 3. If Phase 3 is necessary, any files existing on disk prior to the error failure are lost (unless they are already backed up on tape).

Phase 1: Restart Routine

Press STOP, RST, LDP, LDC, START pushbuttons in that order.

Phase 2: One-Card Bootstrap (Sentry VII, VIII)

If data in the MASTR area of memory is lost:

1. Power up card reader and place DOPSY bootstrap card into hopper face down with top edge toward operator. Place weight on top.

2. Press card reader START and ensure READY indicator is lit.

3. On the FST-2 control panel.
   a) Set switch register to 01000100.
   b) Place FST-2 switch in FST-2 mode (up position).
   c) Press STOP, RST, LDP, LDC switches in that order.
   d) Press LDCR and ensure DOPSY bootstrap card is read.
   e) Press RST and START.

   The DOPSY monitor is loaded and the following message is displayed on the VKT:
   JOB?

4. To initialize the desired job identification type:
   JOB 'jjjj'

5. If this fails to give DOPSY monitor control, then DOPSY is not resident on disk.

Phase 3: Reload MASTR Software

Perform LOADING MASTR SOFTWARE procedure.

System Error Messages

ADDR Not Found In TOPO RAM

Topological scrambler not properly programmed. Some device addresses not specified.

Address Translate Error

Address error detected while trying to address a control file record.

Array Size Exceeded

Value for LOC greater than internal XGRAPH buffer size (1250).

Array Too Small

Array declared for IBUS read too small to hold data.

Backup Limit Reached

Save buffer exhausted while backing up.

C Too Large or XMAX/YMAX

User specified incorrect value for C in PPLOG command or XMAX/YMAX value in PPM or FACTOR program.

Cannot Do Again

AGAIN invoked but SPLOT not loaded with KEEP option or SPLOT last used with different test plan name.

Checksum Error Occurred During Tape/Disk Read Sector # =nnnnn Error In nnnnn

Reload tape.

C.I. File Illegal

Core image files cannot be loaded with object files.

Composite Limit of 4096

No more than 4,096 composite passes for XGRAPH.

Control File Format Error File ffffff-REC ##

Syntax error in record ## of file ffffff.

CRAM Empty

PPLOG executed at other than REXEC statement.

Delta Error

a) Error return from IOCS due to peripheral error or file not found.

b) Third file name is specified, and the first interpretive opcode is not DCL or has undefined contents.

c) Record length 0: something wrong on initial write to file.

d) Array of measurements greater than 300 words.

e) Data log measure record contains pin number greater than 120.

f) Over 300 datalog measure records read without reading EOT record.

Data From Old TP

ON or CREATE command entered when memory contains histogram for previous test program. DELETE old data and CREATE a new histogram.

Data Overflow

Disk file not large enough.

Deletion of Usable Information Suppressed

Requested reduction of file size would destroy usable data.

Deljob Error DSRD/DSWT

Irrecoverable disk read or write error.

Device Not Available

Device does not exist or is not online.

Directory Full

File directory full (688 entry limit).

Disk Error Program Aborted

Disk hardware error.

Disk Error Sector # =nnnnn in nnnnn Program Aborted

Disk hardware error.

Disk File Busy—Pack Aborted
Disk files must be closed before initiating PACK.

Disk I/O Error
File prefix in DCL statement to replace 'LMI' was all blanks or more than 3 characters.

Disk Overflow
Requested space not available on disk.

Disk Write—Program Aborted
Disk cannot be written on. Either DCU or disk write disable switch is set.

Duplicate File
File already exists with attempted new file name.

Duplicate Histogram
Identical CREATE command already entered.

End of File Input
End of tape reached without finding test program.

EOF End Assumed
Source file exhausted but no END statement read.

EOF Input
EOF found while reading input.

EOF on f (where f=1 or 2)
Two files not the same length.

EOT Foilmark. Assembly Aborted
Self explanatory.

Error—Cannot Create File 'ffffff'
Editor could not create file.

Error—Contin Loop in SPM Program
SPLOT will not do ENABLE TEST MOMENTARY on SPM programs.

Error ffffff Could Not Be Found

Self explanatory.

Error—Could Not Find Control File ffffff

Self explanatory.

Error—Disk Overflow

While generating object to working storage, disk space is exhausted. Assembler quits immediately.

Error—ffffff Does Not Verify Correctly

File does not have same verify number as input number.

Error—End of File on Output

No more room in output file.

Error—End of File Working Storage

End of file detected on write to memory working storage.

Error in ARR Area

Irrecoverable error in area where Automatic Restart Routine is located.

Error in COMM

Name entered not found in MACTAB or disk directory.

Error in CTRL Record

Format of a control record is incorrect.

Error in Directory Area

Irrecoverable error in area where directory is located.

Error in File Data

Checksum or parity error has occurred.

Error in File ffffff Job jjjj

Error in area where file ffffff or job jjjj is located.

Error in File Parm

Invalid device specified.

Error in File Size

No more space in memory. Release some files and reload.

Error in File Spec/Specification

a) Error in calling sequence, or named file not string type.
b) Named file is not the same type as specified.
c) Output device specified, disk file cannot be opened or file type incorrect.
d) Input file not in directory under current job number.
e) Old file cannot be located.
f) Only input devices allowed in S, I, and O Editor directives.

Error in File Specification/Type

Source file cannot be located or type is wrong.

Error in File Type

a) One file type does not match the other.
b) Only source files may be edited.

Error in Name

a) First file name not found in current job or second file named exists in current job.
b) File not found in current job or exists in other job.

Error in Numb

a) Illegal name or number specified.
b) Time not entered properly.
c) Invalid device specified.
d) Error in parameters for ALTER.
e) Required parameter missing or incorrect.

Error in PPM

No PPM in this system, hence STOP and LOOP invalid.

Error in Size

a) Less than 48 words left in memory.
b) ALTER request exceeds 40 limit.

Error in STAT

Station number missing and no default established.

Error in REQ SEQ - ffffff

Object file ffffff has been scrambled. No room on disk.

Error in Record Size

Data record cannot be less than 2 or more than 20 words.

Error—Invalid File Name

Same file specified for both input and output, or attempt to EDIT $DRCT or $ARR.

Error—Invalid Unit

Illegal tester unit in xunit or yunit parameters of SPLOT.

Error—Missing Parameter

Self explanatory.

Error—Symbol Table Overflow

While building the symbol table, the memory is exhausted. Assembler quits immediately.

Error—Too Many Variables Referenced in Control File ffffff

More than 20 variables used in file ffffff.

Error—Unit Already Used

Cannot use same tester more than once.

Error—WS Empty

Repeat (//R Edit directive) requested with no data in working storage.

File Contains Non-DMA Code

Interpretive FACTOR object code encountered in LMI file loaded.

File—ffffff of Job jjjj is Not in Directory

Self explanatory.

File/File LMInnn Empty

Attempt to load from an empty file.

File LMInnn Not Found

Disk file LMInnn was not assigned.

File LMInnn Not a Module File

Cannot load a non-LMI type file to local memory.

File LMInnn Not in MASTR Format

Cannot load a TOPSY type LMI file to local memory.

File LMInnn Too Small

File too small to hold amount of local memory being saved, or LMI000 assigned less than 66528 words.

File LMInnn Produce Load Error

Software error while attempting to load file from disk.

File Name Error

a) %SHMXX not assigned or assigned name incorrect.
b) File name not found.

File Not Found

Self explanatory.

File Not Found For Output—Using Working Storage

Output file not on specified media and working storage is used. Requested file created when edit terminates.

File Not in MASTR Format

Attempt to load local memory from TOPSY file.

File Too Small

Old file not large enough for new data.

File Type Wrong

File found but different type than specified.

File" VFY" Skipped

All ampersand files are ignored.

File %SHMXX Not Opened

File not opened prior to compositing or plotting results to output device.

First Character of File Name Must Be a Dot (.)
DOPSY DIF/DOF file name must begin with a dot.

Floating Output, Step or XMAX/YMAX Error
Open socket or loadboard not installed; output pin improperly terminated. Incorrect STEP or XMAX/YMAX specified.

Hardware Not Available
Program on high speed test head is requesting use of EC0/EC1 RVSs.

Histogram Error
Computational error in forming histogram.

Histogram Missing
Histogram identified in LIST, ZERO, or DELETE not found.

HPLOT Error
Undefined datalog record ID code encountered.

IB Error—Status n
Error during bus operation.

Illegal I/O Combination
Output device specified for input or vice versa.

Illegal Test Option Combination
Illegal combination of options in SPLOT command. (e.g. MATCH and AMATCH)

Input File Start
Beginning of input file found while backing up.

INV CKSUM ffffff
Object records have bad parity.

Invalid File Name
a) Input mnemonic is not valid or specified file cannot be found on disk.
b) File name started with blank or was reserved name ($DIRCT or $ARR).

Invalid File Type
Specified file is not a source file.

Invalid Identifier
Identifier returned by SCAN not valid.

Invalid Job Number
System job number (←←←←) cannot be renamed.

Invalid Number—Error In Number
FRQ not followed by valid integer (0 to 99).

IOCS Error
Peripheral data transfer error.

I/O Error
Unable to read from device.

I/O Error on Disk
Disk not on-line.

nnnnnn Is Entry Point
Neither DEBUG nor main program processing statements were loaded.

ffffff Is Paging
File needed on disk and may not be deleted.

Letter In Verify Number
Letter found while reading verify number from input command.

Line Printer Not Ready
Self-explanatory.

Loading Below 220B
Programs cannot load between 0 and 220B.

Mag Tape I/O Conflict
Magnetic tape is specified as both input and output.

Mag Tape Write Error
Cannot write to tape.

MASTR LMI File—No Convert
Cannot convert a MASTR format LMI file.

Memory Full, Can't Expand Symbol Table
Available memory cannot hold all symbols for SPM LOCAL MEMORY TABLES.

ffffff Missing
Named file not located. Remainder of command processed.

Missing Parameter
File(s) omitted or non-blank string not present.

Monitor Record Ignored
a) Source line starting with // has appeared. It is output during the 1st pass. The line is skipped.
b) Source file contained monitor record.

N Out of Range
N exceeds legal range.

No Entry Point
EXEC cannot determine where to transfer control.

No File Name
No file name specified or did not precede verify number.

No File Type
No file type specified or did not precede verify number.

No Object Program Generated
No machine instructions were loaded.

No Space Available
Insufficient space available to CREATE histogram.

No Station Given

No STATn given in call SPLOT and no default defined.

No Write-Ring

Self explanatory.

Number Encountered When Not Legal

Number found before open parenthesis.

Output File Start

Beginning of output file found while backing up.

Overflow

Program must be segmented.

Page Out of Range

LMI PAGE exceeds legal range (000 to 999)

Parameter Error

a) Not enough parameters in XGRAPH call.
b) Unrecognizable parameter in input command.

Partial File in Memory

VERIFY does not work on files only partially in memory.

Partial XREF Listing to nnnnn

While picking up references, the memory is exhausted at address nnnnn. References including and beyond this address will not be included.

POD Error

Could not write to POD.

Precede File Name with DIF, DOF, SDIF or SDOF

A file cannot stand alone.

Program Too Big

Program too big for available memory.

Range or Magnitude Error
Tester unit value incompatible with current range.

RSLT=2
Functional fail occurred on first try of the binary search procedure (TTIME).

RSLT=3
No functional fail occurred within search window (TTIME).

%SHMnn File Too Small
File not assigned required 1,251 words.

Sorry, SPLOT Is Busy
SPLOT invoked from keyboard while servicing FACTOR call.

Special Char In Verify Number
Self explanatory.

Start Add-Greater Than Page Size
Start address greater than page size.

Step Too Large
User has specified, or PPLOG has calculated, a value for STEP that exceeds the scope of the PPM program.

STOP Exceeds LM Size
Self explanatory.

STOP Out of Range
STOP exceeds legal range (0 to 4,095).

Subroutine Nesting Error In Control File ffffff
More than 5 levels of nesting in control file ffffff.

Symbol Table
Symbol table too small for assembly.

Symbol Table Overflow
Too many PROC records in object programs being loaded.

System-1

$UPDAT overlay missing.

System-2

a) DIF/DOF procedural error.

b) FCOMP not able to output a no-compare record.

System-3

Directory cannot be opened or closed.

System-4

Working storage cannot be opened or closed.

System-5

$ASM1 cannot be found on disk.

System-6

$CREATE or $CREA2 cannot close a file just created.

System-7

$CREA2 overlay missing.

System-8

$EXEC overlay missing.

System-9

Working storage is exhausted or input start address greater than top of WS + 1.

System-20

FCOMP1 (phase 2 of FCOMP) could not be loaded.

Tape Is Not Positioned at BOT—Program Aborted.

Self explanatory.

Tape Unit Not Ready—Program Aborted

Self explanatory.

Too Many Units
More than 20 tester and dummy units requested.

Unable to Write to Tape—Program Aborted.
Check tape and tape unit.

Unit Missing
Unit number missing from IBUS command.

Warning—End of Tape on Search
End of tape found before specified file.

Warning—Error on Delete of File ffffff.
Editor could not delete ffffff.

Warning—Invalid File Name Specified on Exit
Different filename given in // 'ffffff'.

Warning—Refresh Counter not Restored
RFC register is write only. SPLOT cannot restore original value.

Warning—Repeat Function not Implemented
REPEAT requested without working storage for output device.

Write-Ring Missing—Program Aborted
Self explanatory.

Wrong Number of Arguments in EXEC
Less than 6 or more than 9 arguments in EXEC SPLOT statement.

Wrong Number of Digits Found
VERIFY number not 8 octal digits long.

Wrong Station on Line
Self explanatory.

XMASK/YMASK Error

Incorrect mask values specified in PPM or FACTOR program, or a READ RAM rather than a WRITE.

XREF Table Overflow—No XREF Listing

While building symbol list for XREF, the memory is exhausted. Cross reference will not be produced; it is output during the first pass.

Compile Error Messages

variable-name Already Defined

Duplicate definition of variable within the same block.

Compiler Generated "Enable Test"

Number of SET F statements exceeds local memory size defined by SET PAGE.

Disk Overflow

Not enough available space on disk.

End of File Input

File exhausted without finding END statement.

Excess Block—STOP OBJ

Legal nesting limit (8) exceeded.

Excess Variables—STOP OBJ

a) Number of variables per block exceeds limit (1019 or 958 for block 0)

b) Number of parameters in EXEC statement exceeds limit (63).

Expression Syntax

An expression has been written incorrectly.

Fatal Error. Circular Expansion

Endless loop encountered in a MACRO expansion.

File Name Error

Incorrect file name used with INSERT statement.

File Type Error

Wrong file type used for INSERT file.

Illegal Instruction

Statement not applicable to system.

Illegal with HS

Statement not allowed with SET PAGE, HS.

Illegal with SPM

Statement illegal with SET PAGE, SPM.

Invalid Terminator

Expected terminator or delimiter incorrectly specified or missing.

I/O Device Error

Invalid peripheral specified in READ/WRITE.

I/O Special Error

Incorrect format for READ/WRITE.

Local Memory Not Loaded

No last local memory address defined.

MACRO Source Illegal, Abort

MACRO definition not resident in DIF/MIF file.

Missing Name

Identifier specified incorrectly.

Missing Number

Number not specified.

Missing))

Missing left or right parenthesis.

Missing]]

Missing left or right bracket.

No Set Page

Statement illegal without SET PAGE.

Not a Sentry 8

Statement illegal unless compiling on Sentry VIII, and/or option S8 specified in COMPILE command.

Number Exceeds Limit

Number exceeds hardware capabilities.

Number Exceeds Range

Value specified exceeds limit of range used in tester instruction.

Number Syntax

Number specified incorrectly.

NW Full

Noise word stack overflow: too many noise words.

Pin Missing

No pin list with CONN TG(x) statement.

Program Too Big

Object code generated exceeds 777777B.

Reserved Word Use Error

Reserved word used for identifier.

Requires SPM

Statement not allowed without SET PAGE, SPM.

Set Page Error

More than one SET PAGE or CHAIN mode not compatible with page size.

Sequence Error

Warning: sequence numbers in columns 73 to 80 out of order.

Statement Syntax

Statement incorrectly written.

SS Full

Symbol stack overflow: not enough space in memory for number of symbols used.

Use Error—Defined Usage—[SCALAR/FOR PAR/ARRAY/FUNCT/SUBR LABEL/LM LABEL]

Incorrect use of variables, where SCALAR=simple variable, FOR PAR=arguments in CALL or FUNCT, array=array variables, FUNCT = function, SUBR = subroutine, LABEL = statement label, and LM LABEL = local memory label.

Warning—LOG Ignored

LOG specified in MEASURE PIN instruction is ignored because it is a DMA instruction.

Warning—Number Exceeds Limit

The number used is greater than 16 bits (177777B).

Work Full

Work stack overflow, compound statement is too long.

Terminal Error Messages

Note: See MASTR command terminal errors (TE).

TE	Description
1	No test plan loaded for station
2	Station is disabled—no power
3	DMA did not start
4	Illegal opcode—400 series
5	Illegal opcode—500 series
6	Illegal opcode—600 series
7	Illegal opcode—700 series
8	Illegal macro instruction—set test
9	System error on paging
10	System overlay missing
11	ALLINK file missing (ALLINK=Assembly Language Linkage)
12	Memory full
14	System stacking error—block header
15	System stacking error—work stack entries
18	I/D started before end of previous I/O
19	I/D operation before I/O initialized
21	Value outside of enable ILO/IHI limits
22	Value outside of enable VLO/VHI limits
23	Illegal pin number
24	Delay is negative or exceeds range
25	Local memory request exceeds hardware
	26 Local memory request exceeds set page request
27	Local Memory loop count is < 1 or > 4096
30	Signed magnitude programmed exceeds hardware limit (11 bits)
31	Value programmed for RVS exceeds system option
32	TG delay or width is < 0, = 0, or out of range
33	Period is out of range or < 200ns (5MHz) or < 100ns (10MHz)
34	Period is less than or equal to the width or delay
35	Period range is less than the width range
36	Period range is less than the delay range
37	Width range is greater than the delay range
38	Period/aperiod is < 200ns and RVS exceeds −16 volts
40	I/O error on read/write
41	I/O error on open
42	I/O not opened—disk/integrator/magnetic tape
43	Illegal call to FGOH routine (illegal PID/POD)
44	I/O error on paging
45	Illegal call to FGIO routine (I/O not open)

TE	Description
46	End of binary input file and no on DIFEOF programmed
47	Device already open
50	Parameters passed to subroutine not equal to parameters expected
51	Arithmetic or logical operation overflow
52	Start value of for loop counter is greater than the limit
53	Array elements declared is =0, < 0, OR > 65,535
54	More elements assigned values than array size
55	Attempt to read/write an array to a register
56	Variable passed as a parameter is used as an array
57	Array passed as a parameter is used as a variable
58	Array used before declared
59	Array subscript is < 0, =0, or exceeds array size
60	On fail-type label is in a block greater than the current block
61	Parameters passed to ALLINK file not equal to parameters expected
62	Too many nested repeat operations in I/O format spec
63	Illegal opcode in I/O format spec
65	Old program not compatible with ETM range restrictions
66	All period and TG ranges are not the same—ETM
67	Start or stop exceeds 2 * period minus 40ns—ETM
68	Start equals stop—ETM
70	Extended PMU program on standard system
71	Sentry VII program on Sentry VIII system
72	Sentry VIII program on Sentry VII system
74	ETM program on standard timing system
75	DMA code for set period requested on 5MHz head
76	SPM program without SPM hardware
78	Standard program on 2V/2mV hardware
79	2V/2mV program on standard hardware (1V/1mV)
80	PPM statement without PPM hardware
81	PPM microprogram contains assembly errors
82	Negative module number passed to PPM microprogram
83	Module number passed to PPM microprogram exceeds modules
84	DMA error during load of PPM microprogram
100	Parameter error—LMLOAD/LMSAVE
101	File access error—LMLOAD/LMSAVE

TE	Description
105	Shmoo of DPS current not allowed—SPLOT
106	Forcing range or magnitude exceeds hardware Limits—SPLOT
107	Continuous mode in SPM program—SPLOT
108	Illegal combination of test options—SPLOT
109	Invalid tester register—SPLOT
110	IBUS parameter missing or out of range
111	IBUS hardware error
112	ARRAY TOO SMALL FOR IBUS read
113	IBUS read or write variable overflow
115	Hardware not available—SPLOT
116	Tester register already used—SPLOT
117	Too many tracking units—SPLOT
120	Global variable number exceeds range defined by file size—GLOBS
121	Parameter error—GLOBS
122	Parameter error—TTIME
123	Enable test continuous in progress on call—TTIME
200+	Reserved for user overlays

ASM/RASM Error Messages

ASM Errors

Error Code	Description
A	Address overflow.
D	Duplicate label.
E	Declared as entry point.
L	Label error.
N	Not used.
O	Operand error.
R	Relocation error.
S	Syntax error.
U	Undefined symbol.
V	Data overflow.
X	External symbol.
↑	Sequence error.

RASM Errors

Error Code	Description
B	Nonbinary operand—a binary value was expected but not found.
D	Duplicate label.
F	Duplicate function in a word—The same function is repeated within a word, such as two Write functions within one AGEN word.
I	Illegal instruction—an AGEN instruction was found in a DGEN word or vise-versa.
N	Operand is noninteger or a negative integer, such as ORG -4 is illegal.
R	Nonregister or negative register in operand—related to INC, DEC and L microinstructions, that require positive register mnenmonics in the operand.
S	Incomplete statement—Statement is missing a required operand, such as OP X1.
U	Undefined label.

DOPSY Commands

Note
DOPSY commands are not valid on Sentry V.

ASM (input/'ffffff') (output/POD) (LIST) (INSEQ) (SPASS) (XREF) (OBJ/OBJECT) (SYM) (FST1)
Assembles an assembly language string file from specified input device or named file.

LIST	Requests a full assembly listing.
INSEQ	Checks card columns 73-80; flags records out of sequence.
SPASS	Single pass assembly (forward symbolic reference only).
XREF	Cross reference listing (ignored if SPASS specified).
OBJ/OBJECT	Generates object file in WS at end of assembly.
SYM	Produces a symbol table listing.
FST1	Generates FST1 object code (default is FST-2 object code).

ASSIGN 'ffffff' integer1 (WORDS/SECTORS) (STRING/DATA (integer2))
Assigns or changes space for a new or existing file.

integer1	Number or words or sectors assigned or changed.
integer2	Record size (2 to 20, default 18) for a DATA file.
WORDS	Specifies file space in words.
SECTORS	Specifies file space in sectors.

CREATE 'ffffff' (OVLY) (input/ws) (STRING/OBJ/OBJECT/DATA (integer1))
CREATE 'ffffff' (OVLY) COREIMAGE (DEBUG) (XPND) (integer2) (CTRL) ('fffff1'/input/ws)
Creates disk files of the type specified.

OVLY	Existing disk area used for new file (file must fit).
integer1	Record size (2 to 20, default 18) for a DATA file.

(See EXEC for description of DEBUG, XPND, integer2 and CTRL.)

CRUNCH 'file' lmsiz (120)
DOPSY utility that processes non-SPM Local Memory "LMI" files by replacing redundant SET F's with equivalent SET FC statements. NOTE: CRUNnn files must be assigned type MOD under MASTR.

'file' 3 or 4 character file prefix designator.
lmsiz Decimal or octal maximum number of LMI words to be placed in generated CRUNXX files.
120 Output run on 120-pin tester.

DBUP (Verify/Verify Only) ('message')
Creates a magnetic tape copy of the disk and allows verification of the copy.

VERIFY Automatic verification at completion of backup procedure.
VERIFY ONLY Verification only, no data transfer occurs
message Maximum 48 valid characters (except @ or single quote) enclosed in single quotes.

DELETE (ws/'fffff1' (,'fffff2','fffff3'))
Deletes either working storage or up to three named files.

DELJOB
Deletes all files under a specific job or all files of a specific type from either all jobs except system job, or a specific job.

EXEC input/'ffffff' (integer) (CLEAR) (DEBUG) (MAP) (CTRL) (XPND)
Loads and executes either object programs or core image programs.

input	Any combination of valid input devices or DIF. Order of load: TTK, CR, MTR, DIF, disk file, working storage. // is peripheral terminator for CR or TTK; $$ is Dif file terminator.
integer	Address of first location loaded (default is 220B
CLEAR	Zeros memory from load point up (core image files 500B up).
DEBUG	Loads DEBUG oberlay.
MAP	Lists address +1 of highest location loaded, followed by names and addresses of all PROC statements.
CTRL	Forces load or no load of specified files (either system or current job). Order of specification determines loading sequence. CTRL format is: [LOAD/NOLOAD]'fffff1'(,'fffff2','fffff3') // terminates the LOAD/NOLOAD sequence.
XPND	Allows loading of programs with overflowing symbol tables.

FCOMP 'fffff1' ('fffff2')
Compares a disk file to working storage or compares two disk files. Both files must be under the same job number or name, and must be the same type.

FDUMP WS (output)
FDUMP Directory (' /↑↑') (output) ('ffffff')
FDUMP ('ffffff'/WS) (OCTAL/SEQ) (integer) (output) (WS)
File dump of working storage, directories or individual files.

(' /↑↑')	Display or print entire contents of directory for the complete disk. (NOTE: Space required before slash).
integer	Number of records to be output for named file or WS.
OCTAL	Output in octal format.
SEQ	Sequencing. "=" prompt requires 8 character alphanumeric identifier. Starting with this identifier, a string file is sequenced by tens (other files by ones).

FETCH [Direct (LP/TPP/POD)/'ffffff']
FETCH (jjjj)
FETCH Update

Prints the directory of a DBUP tape, retrieves a named file, or all files under a specified job number and loads into the current job, updates the disk with files from the current job, and if S specified loads the system job.

JOB 'jjjj'

Places DOPSY in user's job. ("Jobbing-in" required after the system bootstrap procedure.) JOB 'jjjj' initializes system to process a new job.

Caution

Information in working storage is lost. JOB'←←←←' initializes system to process system job.

MASTR (CLEAR)

MASTR monitor call. Clear to initialize.

PATCH ('ffffff')

Examines or modifies files on disk with a set of directives; also used to calculate (adding or subtracting) values. A file must be opened before entering all directives except calculation. Input is from system PID: numbers are assumed to be decimal unless followed by octal B. Addresses for string, DATA, and object files must start relativeto first word of file. Addresses for core image files must correspond to absolute memory location of file to be patched. Output is listed to POD, numbers are displayed in octal.

PATCH directives:

O 'ffffff'		Open the named file.
Cn_1(n_2. . . n_x)		Calculate the value of $n_1 \pm n_2 . . . \pm n_x$.
D		Return control to DOPSY monitor.
Rn	(*comment)	Read the contents of the address specified or the contents of addresses n1 through n2 and display.
$Rn_1,-n_2$	(*comment)	
Rn_1,n_2	(*comment)	
R	(*comment)	Display content of the following address, once an address is supplied. Current location is bumped and contents of next address location displayed.
B	(*comment)	Display content of the previous address. Current location is decremented and contents of previous location displayed.

W n:n_1 (*comment) Wn;n_1,n_2. . . ,n_x (*comment)	Write value specified into address location. If more than one value is entered, separated by commas, consecutive addresses are altered beginning with address specified.
E (current address:) :n_{12}(,n_x. . . ,nx) (*comment)	Alter contents of current address. PATCH responds with address of current location, followed by a colon and carriage return. The value entered becomes the contents of the current location. If more than one value entered, separated by commas, consecutive addresses are altered beginning with the current location. The current location becomes the address corresponding to the last value entered.

RENAME 'fffff1', 'fffff2'
RENAME JOBNUMBER 'jjjj'
RENAME JOBNUMBER 'jjjj' 'ffffff'
Renames a file in the current job, places all files in current job under specified job number, or transfers a file from the current job into the job number specified.

Note
A file cannot be transferred from the system job.

SET (input/DIF('.ffff1'/.IFILE)) (output/DOF('.ffff2'/.OFILE))
Selects or changes PID/POD to specified peripheral devices(s), or sets PID and POD to disk files. File name, if specified, must begin with period.

2 MASTR Command Language

Parameter Definitions

File Types:

COREIMAGE/CI	File with a one-to-one correspondence to executable CPU instructions located in absolute address locations.
DATA/D	A file containing fixed or variable length data.
DV	Variable length data file.
MOD	A FACTOR language module compiled by MASTR compiler or an LMLOAD overlay.
OBJECT/OBJ/O	An assembly language object file. Same type as coreimage plus relocatable information.
OVLY	An assembly language program written as a MASTR overlay.
SOURCE/S	A FACTOR or EXTENDED FACTOR source program.
TP	A FACTOR test program compiled by the MASTR compiler.
U	Undefined. A working storage file with no file assigned or a DOPSY assembly language file that does not correspond to any MASTR file type.
'jjjj'	Job name or number. Maximum of 4 alphanumeric characters enclosed in single quotes are used.
STATn	Associated test station, where n = 1, 2, 3 or 4. If not specified, the station defaults to the station specified in the SET STATn command.
'ffffff'	File name (up to 6 alphanumeric characters enclosed in single quotes are used).
WS	Working storage.

Input/Output

DIF/DOF are used as default on disk based systems and MIF/MOF are used as default on a memory based system whenever a filename is entered.

Input

PID	System PID (PID1 or PID2 depending on VKT usage)
TTK/VK1	VKT1 input
VK2	VKT2 input
CR	Card reader input
MTR/MTR1	Magnetic tape drive 1 input
MTR2	Magnetic tape drive 2 input
MIF 'ffffff'	Memory input filename
DIF 'ffffff'	Disk input filename
CLI 'ffffff'	Com Link input filename (transfer from Integrator)

Output

POD	System POD (POD1 or POD2 depending on VKT usage)
TTP/VP1	VKT1 output
VP2	VKT2 output
LP	Line printer
MTW/MTW1	Magnetic tape drive 1 output
MTW2	Magnetic tape drive 2 output
MOF 'ffffff'	Memory output filename
DOF 'ffffff'	Disk output filename
CLO 'ffffff'	Com Link output filename (transfer to Integrator)

MASTR Overlays

Overlay Name	FACTOR Callable	MASTR Callable	Uses Tester Hardware	
ASM	No	Yes	No	2-4
COPY	No	Yes	No	2-6
CREATE	No	Yes	No	2-6
CYCLE	No	Yes	No	2-7
DATAIO	Yes	No	No	2-7
DATALOG	No	Yes	Yes	2-8
DEBUG	No	Yes	No	2-8
DELTA	No	Yes	No	2-10
DIRECT	No	Yes	No	2-10
DIST	No	Yes	Yes	2-10
DLREG	No	Yes	Yes	2-11
EDIT	No	Yes	No	2-11
EUNIC	Yes	No	No	2-14
FST	No	Yes	Yes	2-14
GETXY	Yes	No	Yes	2-14
GLOBS	Yes	No	No	2-15
HPLOT	Yes	Yes	No	2-15
IBUS	Yes	Yes	Yes	2-16
LABEL	Yes	Yes	No	2-17
LITOP	Yes	No	No	2-18
LMIO	No	Yes	Yes	2-20
LMLOAD	Yes	No	Yes	2-20
LMLRN	Yes	No	Yes	2-21
LMSAVE	Yes	No	Yes	2-23
MA	No	Yes	Yes	2-25
MBUP	No	Yes	No	2-35
PACK	No	Yes	No	2-35
PPLOG	No	Yes	Yes	2-35
PSCAN	Yes	Yes	Yes	2-36
PXLOG	No	Yes	Yes	2-37
RASM	No	Yes	No	2-37
RLREG	Yes	No	Yes	2-38
RUN	Yes	Yes	No	2-38
SFXFR	No	Yes	No	2-38
SPLOT	Yes	Yes	Yes	2-38
TDX	No	Yes	No	2-41
TE	No	Yes	No	2-43
TPEDIT	No	Yes	No	2-43
TTIME	Yes	No	Yes	2-43

Overlay Name	FACTOR Callable	MASTR Callable	Uses Tester Hardware	
VERIFY	No	Yes	No	2-45
VPLOT	Yes	No	No	2-45
WAIT	Yes	No	No	2-46
XGRAPH	Yes	No	No	2-46
XMIT	Yes	Yes	No	2-48

MASTR Commands/Overlays

ALTER n1 n2 (STATn)
ALTER [n1/ALL] OFF (STATn)
ALTER LIST (STATn) (output)

Alters statements or displays altered statements of the test program currently assigned to STATn. Maximum 40 alters allowed.

n_1	Integer which specifies the statement number.
n_2	New value assigned to variable in place of test programs assignment.
ALL	Turns off all ALTER requests used with OFF.
OFF	Resets ALTER requests for all statements or specified statement.

ARR variable-number (element-number) (STATn) (output)

Displays contents of specified array element.

variable number	Unique number assigned by compiler (symbol table) to array or variable.
element number	Element number of array displayed. Default = display array size.

ASM input (object-output) (list-options) (options)

Translates assembly language source programs into FST-1 or FST-2 hardware instructions codes using selected file names and devices as input and output.

input	(TTK/VK1/Vk2/CR/CLI/DIF/MIF) ('ffffff')
object-output	(OBJ/NOBJ) (DOF/MOF) ('ffffff')
list-options	(TTP/VP1/VP2/LP/CLO/<u>POD</u>)
options	(SYM/NSYM) = Symbol table output or not.
	(LIST/NLIST) = Selects list/nolist of assembler output.
	(XREF/NXREF) = Output cross reference table or not.

ASSIGN 'ffffff' n (device) (TP/OVLY/MOD/DATA/OBJ)(S)
Creates a file in memory or on disk by assigning n words from working storage (in integral 48 word sectors for DIF/DOF); expands or shrinks a file in memory to n words.

Note
In ASSIGN ' MACTAB'n, n = number of file names in table.

device	DIF/DOF or MIF/MOF.

CLEAR (STATn)
Resets all altered conditions established by MANUAL, STEP, PAUSE, MODIFY, SYNC, LOOP, STOP, READ, WRITE, MEASURE, DISPLAY, OVERRIDE, and ALTER; zeros all tester globals (except SN = 1); cancels DATALOG requests and TITLE; suspends data accumulation by Parameter Distribution and DC FAIL Analysis; closes devices and files associated with the station, but original is still loaded.

CLOSE input/output (STATn)
Closes a file previously opened and used for binary I/O.

input	DIF/MIF/MTR1/MTR2.
output	DOF/CLO/MOF/MTW1/MTW2.

COMPILE (source-input/PID) (data-output) (list-output/POD) (compiler-options)
Allows background FACTOR compilation in MASTR.

data output	(OBJ/NOBJ) (DOF/MOF 'ffffff')
list output	(LIST/LOBJ/LMAC/LCON) (POD/TTP/VP1/VP2/LP/MTW/MTW1/MTW2/CLO 'ffffff')
compiler-options	(NSEQ) (XREF) (SYM) (MV1/MV2) (S5/S7/S8) (CTRL) (Cn)

COPY (CLMI) (CDOFxx) input/'fffff1'/PID output/'fffff2'/POD (REW) (SKIP yy) (U/B) (OVLY) (S/SOURCE/STRING/O/OBJ/OBJECT/D/DATA/C/CI)

Copies a file from any peripheral or memory to any other peripheral or memory.

CLMI	Conversion from TOPSY LMI file to MASTR LMI file.
CDOFxx	Conversion from TOPSY FDOF file to MASTR format FDOF file (record length "xx" or default 18).
REW	Rewind input magnetic tape before file copy or skip commands.
SKIP yy	SKIP yy files on input magnetic tape before executing COPY command.
U	Unblocked DOPSY FDUMP format compatible.
B	Blocked magnetic tape format DOPSY BMT format compatible.
OVLY	Deliberate overlaying of an existing file.

CREATE core-image-output ((reference-file-output)) object-input (CTRL)

Links and relocates a main assembly language program and its subroutines; or links several assembly language programs to be run as a single program.

core image output	DOF 'ffffff'/MOF 'ffffff'
reference file output	DOF ('ffffff')/MOF('ffffff') Generates reference file of all ENT symbols.

Note

Preceding parentheses are required to delimit file names.

object input	(DIF/MIF) '=ffff1' '=ffff2' . . . 'ffffn'
CRTL	Allows continuation of command options on next line (// keyboard terminator; $$ DIF file terminator).

CYCLE j k (saddr spin)
CYCLE OFF

Establishes a continuous loop between two specified addresses in local memory.

j — Loop start address.

k — Loop end address.

saddr — Address in local memory at which sync pulse is generated.

spin — Tester pin on which sync pulse generated at location saddr is to appear.

OFF — Terminates cycle loop; restores affected registers to their original (pre-loop) states.

EXEC DATAIO (opcode, ioflag, buffer, device);

Performs I/O to disk in variable or fixed length records.

opcode — Constant, variable, or member of an array:
0 Open file.
1 Read one record from DEVICE into BUFFER.
2 Write one record from BUFFER to DEVICE.
3 Close file.
4 Skip N records (+ = forward; − = backward).
5 Position to record N.

ioflag — Filled in by DATAIO
0 or + Successful completion of operation.
−1 End of file (Read); End of file space (Write); File can't be accessed (Open or Close).
−2 Error, needs operator attention or maintenance.
−3 Error in calling sequence.
−4 Data overflow.

buffer — User array of data to be read/written; or variable, constant, or array member containing record length when opening fixed-record file; or variable, constant, or array member containing N for Opcode 0, or 4-5.

device — Constant, variable, or member of an array or array:

0 Working storage file (Use DOF PMF header).
1 Disk file (DIF PMF, open and close via MASTR commands).
2 Disk file (DOF PMF, open and close via MASTR commands).

PMF — Array of 70 words or more (70 + I*48, I=0,1,2. . .)

PMF [1], [2] — Contains file name.
PMF [3] — Contains job number (0 = current job).
PMF [4] – [22] — Reserved for DATAIO use.
PMF [23] – [70] — Disk buffer (DATAIO use only).

DATALOG (DCT)(MEAS)(LOG)(TRIP)(EOT)(FRQn)(FCT(COUNT)(IFM)(n)) (output/POD) (STATn)
DATALOG OFF (STATn)
Allows the following datalogging:

DCT — Log failed dc measurement.
MEAS — Log all measurements.
LOG — Log those measurements with LOG specified in test program.
TRIP — Log all DPS trip failures.
EOT — Log EIR register at end of each test.
FRQrr — Log every nth test.
FCT — Log functional fails (1 per test).
FCTn — Additional functional fails by address per local memory test.
COUNTn — Additional functional fails by test count.
IFMn — Log all functional test failures by address or by count dependent on prog. SET IFAIL stmt.

DATE'mm/dd/yy'
Sets date to specified month, day, and year.

DEBUG ('ffffff') (input/VK1) (output/VP1)
Controls program execution, examines and alters memory contents and examines and modifies CPU and tester registers via a set of directives. (Prompting character is ' '. All address or numbers entered must be true octal numbers (only digits 0 to 7 are valid; no octal designator, such as, "B", allowed). All directives or lines entered from input device must terminate with a carriage return, unless otherwise specified.

Notes

(1) DEBUG is not protected from being moved while busy. If used in conjunction with other operations that may cause memory to move, load DEBUG into memory first with the KEEP option specified.

(2) Once an address halt is entered, depressing the STOP, RST, and START console switches returns control to DEBUG until there is an EXIT from DEBUG, or the address halt has occurred.

DEBUG Directives:

(n1) (,n2)L	List contents of address n1 through n2.
'ffffff' (,n)L	List n or all words of file name.
(n1) (,n2)A	Halt at address n1 after executing n2 times.
C	Continue after address halt.
X	Display all index registers.
AE	Display A and E registers.
AC	Display contents of current address + 1.
DC	Display contents of current address − 1.
nG	Go to address n.
nI	Insert data at address n.
nMA	Modify A register with value n.
nME	Modify E register with value n.
n1,n2MX	Modify index register n1 with value n2.
n1,n2W (CT)	Write tester register n1 with value n2.
nR (CT)	Read tester register n.
D	Exit from DEBUG.
SSW	Display state switches.
n(REL)	Set relative address.
SET	Set line printer as output device.
RESET	Reset output device.
IND	Display indicators.
n1 ± (n2) CAL	Calculate n1 n2 and display.
MON	Go to MONITOR to enter a command.
Carriage return	Single step (address halt after executing next instruction).

DELETE 'fffff1' ('fffff2') ('fffff3')

Deletes up to three named files. Space to working storage is not released.

DELTA 'fffff1' 'fffff2' ('limit-file') (ALL) (n1) (n2) (output/POD)
Compares two sets of device measurement and computes delta values.

'fffff1'	File containing data from first test performed.
'fffff2'	File containing data from second test performed.
'limit-file'	Name of the file containing allowed limits for data comparison.
ALL	Output measurements and computed deltas for all measurements.
n1	Serial number of the first device to be output.
n2	Serial number of the last device to be output.

DEVICE (n/ALL) (OFF) (output)
Closes all devices currently active or one at a time as specified by n; or displays the current state of the IOATAB. PID/POD not affected.

DIRECT (VP1/VP2/LP/CLO/TTP) (S/SOURCE/O/OBJECT/OBJ/D/DATA/C /COREIMAGE/CI) (A/ALL/CURJOB) (WS) ('ffffff') (n)
DIRECT (MTR1/MTR2) (n/ALL)
Outputs disk directory entries, the directory of an MBUP tape, all directories of a TDX tape, and working storage space available.

DIST CREATE (SIZEw) (INDx) (TTy) (PINz) (STATn)
DIST DELETE (INDx) (TTy) (PINz) (STATn)
DIST DELETE ALL (STATn)
DIST LIST (INDx) (TTy) (PINz) (STATn) (output)
DIST LIST ALL (STATn) (output)
DIST ZERO (INDx) (TTy) (PINz) (STATn) (output)
DIST ZERO ALL (STATn) (output)
DIST ON (FRQt) (STATn)
DIST OFF (STATn)

Allows parametric test data to be maintained in the form of discrete distribution functions.

CREATE	Allocates space for specified histogram, initializes the histogram, and activates the data collection algorithm for the station.
DELETE	Removes then reinitializes specified or all histogram(s).
LIST	Writes contents of specified or all histogram(s) to specified output device.
ZERO	Lists then reinitializes specified or all histogram(s).
ON	Reactivates data collection after OFF or CLEAR command or specifies the data collection frequency.
OFF	Suspends data accumulation.
SIZEw	Number of cells assigned to histogram (default 20).
INDx	Binning INDEX for histogram (default 0).
PINz	Pin(s) for histogram (default 0).
FRQt	Data collection frequency.

DLREG (LP/MTW/'ffffff'/VP1/VP2)

Displays the contents of all long pin registers at any specified SPM cycle count of local memory execution.

DOPSY

Returns control to DOPSY. Files created or changed in memory are lost.

Note

DOPSY does not apply to Sentry V.

DUMP 'fffff1' ('fffff2') ('fffff3') (DOF/CLO/MTW1/MTW2)

Transfers up to three files from memory to specified output device.

EDIT ('ffffff'/(DIF/MIF/MTR/MTR1/MTR2['ffffff']) (output/ws) (OVLY)

Allows editing of source files in MASTR with a set of directives. Prompt character is ">".

File Handling Directives:

O 'ffffff'	Open file.
O DEV 'ffffff'	Open named file from DIF, MIF, MTR, MTR1 or MTR2.
I 'ffffff'	Insert named file into output file.
I DEV 'ffffff'	Insert specified DIF, MIF, MTR, MTR1, or MTR2 file into output buffer.

Record Oriented Directives:

C (n) (label) (label+n)	Copy next, all up to nth or labeled, or up to label+nth record.
CEOF	Copy to end of file.
D (n) (label) (label+)	Delete next, all up to nth or labeled, or up to label+nth record.
I	Put in insert mode. Insert prompt character is "=".
V (n) (label) (label+n)	Display following record without copying; copy n−1 and display nth record; copy to label −1 and display labeled record; copy to label + n − 1 and display next record.
A(n) (label) (label+n)	Delete one, n, up to the label or the label +nth record and enter the insert mode. Prompt character is "=".
Mn	Enter insert mode and generate n copies of inserted text (multiple mode).
L(n) (label) (label+n)	List next n, up to label, or up to label + nth record.
P	Same as V but I/O not advanced.

Backup Directives:

B(n)	Backup both input and output files 1 or n records.
BO(n)	Backup input file 1 or n records.
BN(n)	Backup output file 1 or n records.
X(n)	Same as BN.
BS(n)	Backup output file 1 or n records and save changes.

Non-Record Oriented Directives:

V 'string	Copy up to record containing string and display record with string as next record.
V 'string' n	Search for string in n−1 lines, if not found display nth record.
A 'string1' 'string2'	Copy to string 1 and alter contents with string2.
A 'string1' 'string2'n	Scan n records and change string1 into string2 wherever found.
%	Suppress character compare for specific position on alter.
←	Edit end record codes (EOR).

Special Control Directives:

Tn, . . . n20	Enter tab stops; (default 10,16,26,31,45,72).
CTRL-T	Pseudo tab: insert spaces to next tab stop (insert or multiple mode).
(LF)	Line feed key; same as CTRL-T.
E	Enter character edit mode.
Ex	Enter character edit mode and display x lines.
S [CR/TTK]	Change input device that reads edit commands to card reader (SCR) or keyboard (STTK).
L	List output to VKT.
U	Turn off L request.
/ /	Copy to end of file (if output file specified) and exit.
Z 'string'	Replace / / as exit request with string.
/ / R	Copy input file to working storage and create a temporary file for re-editing.
/ /'ffffff'	Copy to end of input file and exit editor.
±	Insert comment line in MIF or DIF edit files.
CS1	Set console switch 1 ON to suppress display.
ABORT	Exit the editor.
/ /	If entered in insert mode immediately following the "=", return control to standard edit mode.

Character Edit Mode Directives:

E(x)	Enter character edit mode and display current line or current line up to the first occurrence of x.
CTRL-R x (CR)	Scan current line and display next occurrence of x.
CTRL-S	Scan and display current line to next occurrence of x, as defined by last E or CTRL-R.
CTRL-N	Advance one character across current line and display.
CTRL-P	Advance across current line or remainder of current line and display.
Character other than Opcodes	Enter character stream at cursor location, extending current line up to 80 characters.
CTRL-B	Backup and delete one character from current line.
CTRL-L, RUBOUT	Restart line scan at beginning, erasing current changes.
CTRL-T	Insert spaces into current line to next tab stop. (Also may be used in insert mode.)
(LF)	Line feed key; same as CTRL-T.
(CR)	Copy current line to working storage.
CTRL-C	Copy current line to working storage and display next line.
CTRL-E	Copy current line to working storage and exit character edit mode.

CTRL-X Exit character edit mode: current line is lost.
CTRL-V The "=" prompting character is returned.
n(CR) Enter n and carriage return. Current line is output to working storage. N−1 records are copied and nth record is displayed and available for editing.
'string' n(CR) Enter 'string'n and carriage return. Input file is scanned for 'string' or for n records. Either the record containing 'string' or the nth record is available for editing.

EOF (n) MTW1/MTW2
Writes one or n number of end of file marks on the tape.

EXEC EUNIC (value, units, result);
Converts values in floating point format into engineering notation in TRASCII format.

value Floating point value to be converted (number range 1E−15 to 999.9 E+12).
units Any single character units suffix (such as 'S' or 'V') previously defined in a DCL statement.
result 2 or 3 word array containing the TRASCII conversion result.

FST (LP/MTW/'ffffff'/VP1/VP2)
Allows display or listing of the sequence of pin data for any specified region of a functional test pattern. Follow the command with an entry of up to 20 tester pin numbers, terminating with a zero. Then enter first and last address to execute.

EXEC GETXY (x,y,step);
Used with PPM or SPM to return information concerning functional fails.

x,y Coordinates of failing memory cell returned to caller following a PPM test execution.
step Following an SPM test execution (the step count at which the fail occurred.)

GLOBAL (number) (value) (STATn) (output/TTP)
Changes global specified by number to value. If value omitted displays specified global. If number omitted displays all globals.

number Number of global variable (decimal integer between 1 and 40).
value Octal or decimal integer or floating point number.

EXEC GLOBS (gnum,op,val,fnum);

Makes available any desired additional number of globals.

gnum	Reference number of global variable (constant or variable).
op = 0	Resets the specified global variable to zero.
1	Increments the specified global by 1.
2	Decrements the specified global by 1.
3	Copies variable or constant val into global variable gnum.
4	Copies contents of global variable gnum into variable val.
val	Variable used to read back value of given global, or place given value into given global.
fnum	Optional two digit file name suffix used only when a memory file name GFILxx has been assigned.

HANG

Inhibits the communication link between tester and Integrator.

HPLOT 'ffffff' (input) (TTP/LP/POD)

Performs statistical analysis of datalogged measurements. The following are entered in response to the "=" prompt: **[meas/tt/inst/arr/lim/plot]** (/ /)

meas	n1 (n2)	(comp) (output)
	n1	Starting measurement number.
	n2	Ending measurement number (optional).
	comp	Composite histogram
	output	Listing device may be changed
tt	n	(comp) (output)
	n1	Test type from the FACTOR program.
inst	n	(pin) (comp) (output)
	n1	FACTOR instruction number of measurement to be plotted.
	PIN	Pin number requested.
arr	n1	(n2) (comp) (output)
	n1	Starting array element number.
	n2	Ending array element number (optional).
lim	(min/max)	
	min	Low limit for histogram
	max	High limit for histogram
plot	(output device)	
/ /	Terminates the HPLOT program.	

EXEC HPLOT (0);
Initializes histogram and clears it to zero.

EXEC HPLOT (0, llim, ulim);
Initializes the histogram with defined limits.

EXEC HPLOT (1, value);
Contents of the variable named in second parameter are added to the histogram.

EXEC HPLOT (2);
Histogram is output to current station output device.

EXEC HPLOT (2, units);
Outputs histogram with units defined along the X-axis in engineering units.

EXEC IBUS

EXEC IBUS (function code, unit, array, error-flag);
EXEC IBUS (function code, command);
EXEC IBUS (function code, unit, command);

Allows communication with instruments in ASCII via the IEEE 488 Standard Bus. Any instrument may be controlled via a FACTOR test program or by a MASTR command.

function code	= 0	Reset.
	= 1	Write ASCII.
	= 2	Read ASCII.
	= 3	Write variable.
	= 4	Read variable.
	= 5	Wait for SRQ (service request).
	= 6	Addressed or universal command.
	= 7	Bus control.
	= 8	User defined bus command.
	= 9	Write variable (integer).
unit		Address of the instrument on the 488 bus.
array		Array name of the data transferred to the instrument or the area defined to receive data from the instrument.

error-flag — Error returned when function code is 5 and no SRQ is received from the instrument. 0 = no error; 2 = error.

command — Special code or command is passed to IBUS from the test program (Contents depend on the function).

JOB ('jjjj'/integer)
Changes the current job name or number to value specified.

LABEL...
Generates messages (up to 7 characters per line on a VKT or 16 on a 132 column line printer) in large block character format. The forms are as follows:

LABEL 'message1' ('message2'...'messagen') (ASM) output)

ASM causes an "*" to be placed in column 1 of each label record.

EXEC LABEL (output, msg1, msg2, ..., msgn);

output = 0	User's VP	
= 1	VP1 (TTP)	Video display ±1
= 7	VP2	Video display ±2
= 4	LP	Line Printer
= 2	MTW1	Magnetic tape unit 1
= 3	MTW2	Magnetic tape unit 2
= 5	DOF	Disk output file. A file named 'LABL' is automatically assigned.
= 8	MOF	Memory output file
= 6	CLO	Integrator line printer
= 11	System POD	
= 12	Station POD	
msg1 . . . msgn	array identifiers of previously declared arrays that contain the label text to be displayed.	

LIST 'ffffff' (n1) (n2) (LP/TTP/POD)
Outputs the contents of a test data file in a datalog-like format.

n1 — Serial number of first device to be listed.
n2 — Serial number of last device to be listed.

EXEC LITOP . . .
Performs a variety of operations of literal variables and arrays. The forms are as follows:

EXEC LITOP (1,n1,n2,n3);
Performs literal AND.

n1 Number from 0 to 15 (4 bits) that specifies which characters to mask. 1 = leave character undisturbed, 0 = mask character.

n2 4 TRASCII characters to be masked.

n3 Optional. If absent, n2 contains mask result that destroys original contents. If present, contains masked result and leaves contents of n2 undisturbed.

EXEC LITOP (2,n1,n2,n3);
Performs literal SHIFT.

n1 Number of bits to shift right. A negative value shifts N1 bits to the left.

n2 Where the result of shifting operation is placed.

n3 Optional. If present, filled with shift operation overflow.

EXEC LITOP (3,n1,n2,n3)
Performs literal OR.

n1, n2 The values 0Red together.

n3 Optional. If present contains the result, if absent the result is in N2.

EXEC LITOP (n1,n2,n3,n4);
Converts literal to floating point.

	Format of n2,n3
n1 = 4	Octal.
6	Hexadecimal.
8	Decimal.

n2,n3 Contains a left justified literal integer as read from the keyboard.

n4 Contains the floating point result.

EXEC LITOP (n1,n2,n3,n4,n5);
Converts floating point to literal.

	Format of n3,n4
n1 = 5	Octal.
7	Hexadecimal.
9	Decimal.
n2	Floating point input.
n3,n4	Contains a right justified number with leading TRASCII zeros.
n5	If non-zero specifies the number of digits returned (optional).

EXEC LITOP (12,n1,n2,f1,f2,...,fn);
Performs array parsing.

n1	Delimiter.
n2	Input string.
f1,f2,fn	First field, second field, nth field.

EXEC LITOP (10,n1,n2,n3)
Performs array searching.

n1	Reference string to be searched for.
n2	4 element array defining the table structure of n3, search region and pointer to n3: n2 [1]—pointer to n3. Returned to 0 if no match found. n2 [2]—table width (number of n3 elements per line). n2 [3]—starting column of search field (element of array n3). n2 [4]—ending column of search field (element of array n4).
n3	FACTOR array to be searched.

EXEC LITOP (13,n1);
Returns date and raw number time maintained by the system.

13	Retrieval code for time in number of seconds elapsed since midnight.
n1	The time (a scalar floating point number described above).

EXEC LITOP (14,n1);
Returns date and the literal TRASCII form of time.

14 Retrieval code of time in literal TRASCII form.
n1 Four element array. Elements 1 and 2 contain the 8 character literal string entered in the MASTR command DATE 'string'. Elements 3 and 4 contain the time (element 3 blank, blank, blank H; Element 4 H:mm.)

LMIO . . .
Transfers local memory data between local memory and a variety of I/O devices. The forms are as follows:

LMIO (DATA/STRING/DEBUG) output
Dumps local memory to output in format specified.

DATA Functional test data in tester executable format as output by the compiler.
STRING Original source format in which test data appeared prior to compilation.
DEBUG Similar to STRING format but condensed so that each line of output contains all programmed data relating to the current local memory location.

LMIO LOAD [PAGE/'ffffff'] (ADDR) (DIF/MIF)
Loads local memory from a file.

LOAD Load local memory with contents of file defined by PAGE or 'ffffff'.
PAGE Number range (000 to 999) appended to prefix 'LMI'.
ADDR Local memory address at which data file loaded.
CLEAR Clears local memory contents to zero.

EXEC LMLOAD (page,n,stop,fileid);
Allows functional test data to be transferred between local memory and files on the disk at run time.

page	Three digit file name suffix between 000 and 999 for use in filename 'LMInnn'. Files must be assigned type MOD.
n = 1	Save local memory contents in the disk file defined by page.
= 2	Load the contents of the disk file defined by page into local memory.
stop	Highest local memory address to be saved in file.
fileid	Optional identifier defined in DCL statement to specify optional three character file name prefix. (DCL FILEID/'XYZ'/;)

LMLRN
Used to generate (learn) a functional test pattern in local memory, scramble data from FACTOR variables to specific pins of local memory, unscramble data from local memory to the FACTOR program, alter the contents of a specified local memory location to pattern required by the device, and allow the FACTOR program to read/write the bits in local memory that are used for mask enable, input enable, time set enable, LMI code.

EXEC LMLRN (1, field1, field2,...);
DCL field1 [8] /5, 6, 7, 8, 15, 14, 13, 12/;
DCL field2 [8] /1, 3, 9, 11, 2, 4, 10, 16/;
Defines pin fields. The first pin of the declaration represents the LSB othe associated array. Pins may be defined when pins are in sequential ascending order and the LSB corresponds to the lowest numbered pin of a rank. Maximum number of pins per field is 16. If the field definition is a scalar, then the associated element of the data arrays corresponds to a predefined field as follows:

1	ENABLE MA/MB (bit 16 of rank 1)
2	ENABLE DA/DB (bit 16 of rank 2)
3	ENABLE TS1 . . TS4 (bit 16 of ranks 3 and 4)
4	LMI OP CODE (bits 13 to 16 of rank c)
5	LMI OPERAND (bits 1 to 12 of rand c)

EXEC LMLRN (2, addr, array);
EXEC LMLRN (3, mad, array);

Read local memory.

2 Unscramble data in local memory location ADDR into the ARRAY.

3 Performs a read as in but gets the local memory address from the tester MAD register.

EXEC LMLRN (4,addr, array);
EXEC LMLRN (5,mad, array);
EXEC LMLRN (4,addr, array, n1,n2,...);
EXEC LMLRN (5,mad, array, n1,n2,...);
Writes to local memory.

4 Write to local memory location specified by ADDR.

5 Read MAD register to determine local memory address.

EXEC LMLRN (7);
EXEC LMLRN (6,addr);
EXEC LMLRN (7,mad);
EXEC LMLRN (6,addr, array):
EXEC LMLRN (7,mad, array);
Read/Fix local memory.

6 Read contents of location ADDR in local memory

7 Read MAD register to determine local memory address.

EXEC LMLRN (8,addr,array);
EXEC LMLRN (9,mad,array);
Read/Fix to user array.

8 Read contents of location ADDR in local memory. Exclusive or with C register and pass result in the ARRAY.

9 MAD register to determine the local memory address

EXEC LMLRN (10,addr,array);
Read C Register

10 Read C register and unscramble in the ARRAY.

EXEC LMSAVE . . .

Similar to LMLOAD but additionally designed for use with microprocessor test generation programs. Currently supports 8 separate functions as follows:

EXEC LMSAVE (page,n,stop, fileid);

Transfers functional test data between local memory and an 'LMI' file. See EXEC LMLOAD parameter descriptions.

EXEC LMSAVE (0,n2,n3,n4,n5,n6);

Transfers single data items between the FACTOR program and file LMI000.

Note

User must first ASSIGN file: 'LMI000' 66528 MOD

n2 = 1 — Place data into LMI000.
= 2 — Fetch data from LMI000.
n3 — Random word address within LMI000 of data being accessed; $0 \leqslant n3 \leqslant 65535$.
n4 — Data in (floating point format) put to or fetched from LMI000. Accesses bits 0 to 15 of word addressed by n3. Must be positive integer < 32767.
n5 = 0 — Normal use of n3 defined above.
= 1 — LMI000 use as destination for peripheral ID data. Utilizes LMI000 addresses beyond 65535.
n6 — Data (floating point format) put to or fetched from LMI000. Accesses bits 16 to 23 of word addressed by n3. Must be a positive integer < 255. n6 is optional and may be omitted.

EXEC LMSAVE (0,n2,n3);
EXEC LMSAVE (0,8,n3,fn 1, fn 2);

Loads file LMI000 with user generated data from an input device.

n2 = 3 — Data input from cards.
= 7 — Data input from magnetic tape.
= 8 — Data input from a disk file.
n3 = 0 — Data in octal.
= 1 — Data in hexadecimal.
fn 1 ,fn 2 — Two word literal array containing disk file name. Used when n2=8.

EXEC LMSAVE (0,9);
Closes file LMI000.

EXEC LMSAVE (0,4,n3,n4,n5,n6);
Converts numbers from floating point to octal or hexadecimal format.

n3 = 0	Conversion to octal.
= 1	Conversion to hexadecimal.
= 2	Reads test count into n5 and n6.
n4	Floating point number to be converted.
n5	Upper 4 characters of result in TRASCII.
n6	Lower 4 characters of result in TRASCII.

EXEC LMSAVE (0,5,n3,n4,n5);
Converts microprocessor opcodes into their corresponding mnemonics.

n3	Opcode in floating point format.
n4	Upper four characters of mnemonic.
n5	Lower four characters of mnemonic.

EXEC LMSAVE (0,6,n3,n4,n5,n6);
Transfers data from input device to FACTOR program.

n3 = 0	Data input in octal.
= 1	Data input in hexadecimal.
n4	First data item in floating point format received from input device.
n5	Second data item in floating point format received from input device.
n6 = 0	Data input from keyboard.
= 1	Data input from card reader.
= 2	Data input from magnetic tape.

EXEC LMSAVE (0);
Performs a line printer top of form.

LOAD 'fffff1' ('fffff2') ('fffff3') (expansion-number) (KEEP) [DIF/CLI/MTR1/MTR2]
LOAD 'fffff1' (SAVE) (KEEP) [MIF/DIF/CLI/MTR1/MTR2] (STATn)

Loads system or user overlays (ALLINK), string or data files or test programs into memory.

expansion number	Number of words desired for expanding the buffer area of overlays which collect data (i.e., parameter distribution).
SAVE	Retains all operator requested conditions, values of globals, and overlay requests in use for the station.
KEEP	Prevents paging out of memory.

EXEC LPLF (numsp, numt);
Performs line printer top of form and line feed functions.

numsp	Number of lines to space. If mission or equal to 0, paper is positioned at top of form.
numt	Number of top of forms to issue.

Manual Analysis
Allows control of certain tester functions from the keyboard. Commands may be entered anytime and intermixed with system commands. A station number must be entered unless default station is previously set by SET STATn. Commands are as follows:

CONTINUE (STATn)
Causes single step mode and manual start mode to be cleared and initiates a start at the station specified.

DISPLAY (PMU)(FCT)(EIR)(TG)(PWR) (CLK)(STRB)(ALL)(RANKn)(ON/OFF)(STATn)
Provides a display of machine status and selected register contents at each pause, end of test sequence, and each step in manual mode.

LOOP address [ON/OFF] (STATn)
Requests microprogram loop mode between address 0 of control RAM and the RAM address specified.

Manual (OFF) (STATn)
Allows starting of tests from keyboard using carriage return instead of START button.

MEASURE [node/node number/pin number] (ON)(STATn)
Causes the PMU to make a measurement and display the results. Measures on next pause if ON is specified; immediately if not.

MODIFY number [DC/TO] [ON/OFF] (STATn)
Allows changing of time delay values. When OFF is specified, the selected delay is returned to program control.

OVERRIDE [ON/OFF] (RESET/ALL/FCT/DCT/TRIP) (STATn)
Overrides the ON [DCT/FCT/TRIP/RESET] statement.

PAUSE (number/FAIL) [ON/OFF] (STATn)
Causes testing to stop at each failure or at a specified statement number.

READ register name (ON) (STATn)
READ functional register (RANKn) (ON) (STATn)
READ F(RANKn)(n)(ON)(A/B)(STATn)
READ LMI (n)(ON) (STATn)
READ [PW/PD/PWV/PDV/APW/APD/APWV/APDV] (n) (ON) (STATn)
READ PPA (PINn) (ON) (STATn)
Allows reading of any tester register and displaying of contents in applicable format. (See tables 2-1, 2-3)

RESET (STATn)
R (STATn)
Identical to pressing RESET button on station control panel.

START (STATn)
Identical to pressing START button on station control panel.

STEP (OFF) (STATn)
Initializes single step testing using keyboard carriage return instead of MANUAL button.

STOP address [ON/n/OFF] (STATn)
Allows stopping of microprogram execution at the control RAM address specified. Issued in conjunction with PAUSE ON command.

SYNC ON statement-number
Generates an external sync pulse at the test station sync connector when specified statement is executed.

SYNC ON local-memory-address ADDR
SYNC ON test-sequence-count COUNT
Generates an external sync pulse at the test station jack labeled EXT SYNC. If ADDR specified, pulse occurs when memory address specified is addressed during functional testing. If COUNT (SPM option) specified pulse occurs at the specified test count during functional testing.

SYNC OFF
Turns off SYNC Options.

TEST (CONT/MATCH/MOMENTARY)(STATn)
Starts local memory test execution in mode specified.

WRITE register-name data (ON) (STATn)
WRITE functional-register (RANKn) data (ON) (STATn)
WRITE engineering-register
(RNG0/RNG1/RNG2/RNG3/RNG4,/(STATn)data(ON)
WRITE PPA (PINn) data (ON) (STATn)
WRITE SPSL (SYM data/ data) (ON) (STATn)
WRITE [PW/PD/PWV/PDV/APW/APD/APWV/APDV] (n)
(RNG1/RNG2/RNG3) data (ON) (STATn)
WRITE DCT (G) (STRB) (RNG0/RNG1/RNG2/RNG3/RNG4) data (ON)
(STATn)
WRITE PPS (V) (RNG0/RNG1/RNG2/RNG3/RNG4) data (ON) (STATn)
WRITE [DPT1/DPT2/DPT3] (I) (G) (RNG2/RNG3) data (ON) (STATn)
WRITE PA (ER/DR) (STATn)
Allows any register to be written in the required format. (See tables 2-2, 2-3.)

Table 2-1 Special Character List For Registers Displayed

Registers	Letter	Description
DPS1, 2, 3, E1, E0, S1, S0, etc.	V	Value is in voltage
DPT1, 2, 3, DPS 4, 5, 6	L	Trip is set less than
	G	Trip is set greater than
	V	Current force, voltage trip
PSL	I	Current sense mode
	V	Voltage sense mode
PPS	I	Current force mode
	V	Voltage force mode
PA	R	The voltage conditioner relay is connected
SPSL (CLAMP)	S	SYM
	+	POS
	–	NEG
	V	Voltage (for CLAMP OFF value equals 0)
DCT	I	Current sense mode (read from PSL)
	V	Voltage sense mode (read from PSL)
	L	Fail if less than
	G	Fail if greater than
	P	Pass
	F	Fail
TD, TR, PW, PD, PWV, PDV, ADR, APW, APD, APWV, APDV, RTD	S	Value in seconds

Table 2-2 Write Formats

Type	Description	Example
octal format	1 to 8 digits followed by B	261B
binary format	1 to 16 bits followed by *, bit 0 is right most bit.	100111*
functional format	1 to 15 bits followed by *, pin 1 is left most bit	100111*
decimal format	0 to 8388607	29
2 octal format	two 3 digit octal numbers	351B 331B
scientific format	1 to 4 digits plus power of ten (must be entered in engineering format)	6.3 nV

Note
To WRITE, an octal or binary register input may be entered in either binary or octal.

Table 2-3 Register List

ID	Special Input	Name	RD/WR	Format
IF		Ignore Fail	R/W	Oct/Dec
INC		Instruction Number Compare	R/W	Oct/Dec
IND		Instruction Number Display	R/W	Oct/Dec
J		Minor Loop Start Address	R/W	Oct/Dec
K		Minor Loop End Address	R/W	Oct/Dec
L		Major Loop End Address	R/W	Oct/Dec
M		Minor Loop Count	R/W	Oct/Dec
MAD		Write: Test Start Address	W	Oct/Dec
		Read: Test Stop Address	R	Oct/Dec
MCS		Local Memory Main Frame Access	W	Oct/Dec
N		Major Loop Count	R/W	Oct/Dec
PA	(ER) (DR)	Pin Address	R/W	Decimal
CH		Chaining	R/W	Binary
EIR		External Interface	R/W	Binary
I		Instruction	R/W	Binary
LRAX		Long Register Address Extend	R/W	Binary
MODE		Mode	R/W	Binary
PPA	PINn	Power Pin Address	R/W	Binary
SAMA		Status and Mode (A)	R/W	Binary

Table 2-3 Register List (Continued)

ID	Special Input	Name	RD/WR	Format
SAMB		Status and Mode (B)	R/W	Binary
SAMC		Status and Mode (C)	R/W	Binary
SAMD		Status and Mode (D)	W	Binary
SAME		Status and Mode (E)	W	Binary
SR		Status	R/W	Binary
STSC		Mux Slave Test Station Control	R/W	Binary
TSC		Test Station Control	R/W	Binary
TSC		Test Station Control	R/W	Binary
C	(RANKn)	Read: Functional Compare	R	Funct
		Write: Invert Register	W	Funct
CRO	(RANKn)	Comparator Relay Open	R/W	Funct
DA	(RANKn)	I/O Pin Definition (A)	R/W	Funct
DB	(RANKn)	I/0 Pin Definition (B)	R/W	Funct
F	(RANKn) (n) (A/B)	Functional Test Pattern	R/W	Funct
MA	(RANKn)	Mask (A)	R/W	Funct
MB	(RANKn)	Mask (B)	R/W	Funct
R	(RANKn)	Utility Relay	R/W	Funct
RZ	(RANKn)	Return to Zero	W	Funct
S	(RANKn)	Data/Clock RVS Select	R/W	Funct
ST	(RANKn)	Strobe Select	R/W	Funct
TG1	(RANKn)	Timing Generator Pin Address #1	R/W	Funct
TG2	(RANKn)	Timing Generator Pin Address #2	R/W	Funct
TG3	(RANKn)	Timing Generator Pin Address #3	R/W	Funct
XOR	(RANKn)	Exclusive OR	W	Funct
APD	n (RNGn)	Alternate Timing Generator Delay	R/W	Eng
APDV	n (RNGn)	Alternate Timing Generator Delay Vernier	R	Eng
APW	n (RNGn)	Alternate Timing Generator Pulse Width	R/W	Eng
APWV	n (RNGn)	Alternate Timing Generator Width Vernier	R	Eng
DCT	(G)(STRB) (RNGn)	PMU Hardware Compare	R/W	Eng

Table 2-3 Register List (Continued)

ID	Special Input	Name	RD/WR	Format
DPS1	(RNGn)	Digitally Programmed Power Supply #1	R/W	Eng
DPS2	(RNGn)	Digitally Programmed Power Supply #2	R/W	Eng
DPS3	(RNGn)	Digitally Programmed	R/W	Eng
DPS3	(RNGn)	Digitally Programmed Power Supply #3	R/W	Eng
DPS4	(RNGn)	Digitally Programmed Power Supply #4	R/W	Eng
DPS5	(RNGn)	Digitally Programmed Power Supply #5	R/W	Eng
DSP6	(RNGn)	Digitally Programmed Power Supply #6	R/W	Eng
DPT1	(I) (G) (RNGn)	DPS TRIP #1	R/W	Eng
DPT2	(I) (G) (RNGn)	DPS TRIP #2	R/W	Eng
DPT3	(I) (G) (RNGn)	DPS TRIP #3	R/W	Eng
EA0	(RNGn)	Reference Voltage Supply	R/W	Eng
EA1	(RNG)	Reference Voltage Supply	R/W	Eng
EB0	(RNGn)	Reference Voltage Supply	R/W	Eng
EB1	(RNGn)	Reference Voltage Supply	R/W	Eng
EC0	(RNGn)	Reference Voltage Supply	R/W	Eng
EC1	(RNGn)	Reference Voltage Supply	R/W	Eng
E1	(RNGn)	Reference Voltage Supply	R/W	Eng
E0	(RNGn)	Reference Voltage Supply	R/W	Eng
PD	n (RNGn)	Timing Generator Pulse Delay	R/W	Eng
PDV	n (RNGn)	Timing Generator Delay Vernier	R	Eng
PPS	(V) (RNGn)	Precision Power Select	R/W	Eng
PSL	(RNGn)	Precision Sense Level	R/W	Eng
PW	n (RNGn)	Timing Generator Pulse Width	R/W	Eng
PWV	n (RNGn)	Timing Generator Width Vernier	R	Eng
RTD		Round Trip Delay	R	Eng
SA0	(RNGn)	Reference Voltage Supply	R/W	Eng
SA1	(RNGn)	Reference Voltage Supply	R/W	Eng
S0	(RNGn)	Reference Voltage Supply	R/W	Eng
S1	(RNGn)	Reference Voltage Supply	R/W	Eng
TR	(RNGn)	Test Rate	R/W	Eng

SPM Register List

ID	Special Input	Name	RD/WR	Format
FC		Clock Burst	R	Octal
IF2		Ignore Fail #2	R/W	Octal
LC		Loop Count	R	Octal

Table 2-3 Register List (Continued)

ID	Special Input	Name	RD/WR	Format
SPM Register List (Cont.)				
LCS		Loop Count Stack	R	Octal
LMI		Local Memory Instruction (RANK 8)	R/W	Binary
RA		Return Address	R	Octal
SA		Start Address	R	Octal
STAM		Stack Address	R/W	Octal
Q		Sequential Pattern	W R	Binary Binary Inverted
QL		Sequential Length	W	Octal
PPM Register List				
CA		Control RAM	R/W	Binary
CD1		Control RAM #1	R/W	Binary
CD2		Control RAM #2	R/W	Binary
CMP		Compare Address	R	2 Octal
CRA		Control RAM Address	R	Octal
CSMD		Chip Select and Address Mask	W	Binary
DEL1		Delta #1	W	2 Octal
DEL2		Delta #2	W	2 Octal
DEL3		Delta #3	W	2 Octal
DRAM		Data RAM	R/W	Binary
DR1		Data Readout #1	R	Binary
DR2		Data Readout #2	R	Binary
HLD1		Hold Register #1	W	2 Octal
HLD2		Hold Register #2	W	2 Octal
HLD3		Hold Register #3	W	2 Octal
IR1		Index Register #1	R	2 Octal
IR2		Index Register #2	R	2 Octal
IR3		Index Register #3	R	2 Octal
MAX		Maximum	W	2 Octal
RFC		Register Count	W	Octal
SD		Shift Data	W	Octal
SSA		Stop Address and Storage Address	R/W	2 Octal
TOPO		Topological Scrambler	R/W	2 Octal

Table 2-4 Status and Mode Register Bits

SAMA Bit	Function	RD/WR
0	R Local Memory Busy W Start Local Memory	R/W
1	R No match W Match Mode	R/W
2	Momentary Mode	R/W
3	Continuous Loop State	R
4	Functional Fail	R
5	Parametric Fail	R
6	Functional Fail Enable	R/W
7	Parametric Fail Enable	R/W
8	Enable Ignore Fail	R/W
9	Rank Load Mode	R/W
10-11	Memory Size	R
12	Enable Fail in Continuous Loop	R/W
13	Continuous Loop Mode	R/W

SAMB Bit	Function	RD/WR
0	I/O Mode	R/W
1	Sync Mode	R/W
2	Page 2k	R/W
3	Ext Sync	R/W
4	Double Strobe	R/W
5	Chain 2 Mode	R/W
6	Chain 4 Mode	R/W
7	D/L Measure	R/W
8	DA/DB Select (1 = DB) (Rank 1)	R
9	MA/MB Select (1 = MB) (Rank 2)	R
10	MDOR3 Memory Data Out (Rank 3)	R
11	MDOR4 Memory Data Out (Rank 4)	R

SAMC Bit	Function	RD/WR
0	28 V Swing Clamp	R/W
1	SII/S610 Flag	R
2	4 K Local Memory	R

Table 2-4 Status and Mode Register Bits (Continued)

3	Timing Module Option (ETM)	R
4	1 ns Option	R
5	S610 - 10 MHz CTLR	R
6	10 MHz Head	R
7	PPM	R
8	SPM	R
9	Fail Match Clock	R
10	Fail Loop	R/W
11	Count Enable	R/W

SAMD Bit	**Function**	**RD/WR**
0	Data	
1	PPM normal mode, set PPM on	W
2	PPM programmed stop	W
3	PPM programmed loop	W
4	Split cycle mode	W
5	Load alternate timing registers	W
6	PPM local memory address mode	R/W
7	PPM data bit extension	R/W
10	Disable return to one	W
11	Enable multiplexing of F data	W
12	1 conditioning pin vs 3 controlled pins	W
13	Mask input pins	W
14	SPM	W
15	Alternate match mode	W
16	P4K (SAMD 71)	W
17	SPM momentary	W
20	APS interrupt (high-speed-sync (APM))	W

SAME Bit (LRAX)	**Function**	**RD/WR**
0	Spare	W
1	Alternate register bank 1	W
2	Alternate register bank 2	W
5	Alternate bank 2 available	W
11	Alternate register banks 1 and 2 reset by a single write and execute	W

MBUP (MTW1/MTW2)
Writes the contents of main memory to magnetic tape (the boot program, the MASTR operating system and all test programs, system overlays and ALLINK programs that were present in memory at backup time).

NAME ('ffffff'/TP/OVLY/ALL/STATn/MOD)(output
Lists information on current files in memory to specified output device.

NOTE 'message' (output)
Allows messages to be placed on specified output device.

message — Maximum 72 alphanumeric characters enclosed in single quotes.

OPEN [input/output] 'ffffff' (ADD) (STATn)
Opens a named file to be used for FACTOR program I/O or datalogging output.

input	DIF, MIF, MTR1 or MTR2.
output	DOF, CLO, MOF, MTW1 or MTW2.

Note
DOF/MOF file must exist as DATA.

ADD	Appends data to an existing file at the Integrator.
STATn	See parameter definitions.

PACK
Purges all ampersand files and makes the space on disk available as working storage.

PPLOG (ROW n/COL n/STEP n/WALK n/FAIL n/TOPO/c) (TTP/VP1/VP2/LP/MTW1/MTW2)
Pattern Processor datalogging overlay that produces a fail matrix map of the RAM test pattern being executed.

ROW n/COL n — Maximum rows and columns. (n ≤ 64 COL n columns, n ≤ 256 rows. If omitted, automatically computed with increase in processing time.

STEP n For walking type n patterns, where n defines PPM test step (count) encompassed within the read portion of iteration to be plotted.

Note
Must be calculated properly or results unpredictable.

WALK n Computes step count for walking patterns, where n is walk position desired.

FAIL n Suppresses printing of background pattern in failmap and allows status of only failing devices cells through step n to be logged.

TOPO Used with topological scrambler to cause failmap display of unscrambled pattern (a diagonal looks like a diagonal).

c Cycle count (integer) of the number of read/write cycles per cell.

PPLOG Trace Option

A PPLOG function that traces the PPM pattern sequence and logs results to specified output device.

PPLOG TRACE (start/stop/XRn/FAIL) (TTP/VP1/VP2/LP)

start/stop Beginning and ending step count to be included in the trace output.

XRn Number of PPM index register to be included in the trace output, where n is 1 to 3.

FAIL Only failing tests to be included in trace output.

PSCAN p1(-p2) (clk1, clk2, ...clkn) (DBL) (MEAS) (VP1/VP2/LP)

EXEC PSCAN (n);
Displays the status of all programmed tester pins.

p1-p2 Range of pins to be displayed.

clkn clk1, clkn apply only to low voltage test head and define all clockpin numbers.

DBL Double spaced output.

MEAS Output pins measured and results printed as with input pins.

n Highest pin number to be displayed.

PXLOG [RW/WR] [n1/n2]
Displays (to TTP) the sequential event execution of a PPM program.

RW/WR — Displays Read/Write cycles or Write/Read cycles. If both omitted, only read cycles displayed.
n1/n2 — Positive numbers specifying start and stop count.

RASM (input/PID)(core-image-output/POD)(list-output)(LIST)(NC)
Provides a PPM microprogram assembler via the following operations: (1) source translation; (2) listing; (3) generating an executable PPM microprogram. Existing PPM source files must be reassembled with RASM for use under MASTR.

input — Any valid input device or PID default.
core-image-output — DOF 'ffffff'/MOF 'ffffff'/ 'ffffff'/POD.
list-output — Any valid output device (except those specified by coreimage output) or POD.
LIST — Lists source file.
NC — Stops RASM from producing an executable PPM microprogram.

RELEASE ('fffff1' ('fffff2') ('fffff3')/TP/OVLY/MOD/STATn)
Removes file(s), test programs, overlays, or modules from memory; detaches the test program from specified station.

RENAME 'fffff1' 'fffff2'
Renames file to 'fffff2' ('fffff2' must not exist as a name in the same job as 'fffff1').

RENAME JOBNUMBER 'jjjj' 'ffffff'
Changes the job number of a file in memory. The file must be in the current job. The new job name is assigned to the file; the current job number remains unchanged.

RESTART CLO (STATn)
Purges all data from the file currently opened at STATn. Applies to Integrator only.

REW [MTR1/MTR2/MTW1/MTW2]
Rewinds the magnetic tape to beginning of tape (BOT) position.

EXEC RLREG (reg,val);
Reads tester long registers with four digit addresses in either the main or alternate register bank.

reg — Four digit register address expressed as assigned octal constant. Plus = primary bank; Minus = alternate bank.

val — Contents of the referenced register returned as a floating point number.

RUN 'fffff1' ('fffff2') ('fffff3') (TRACE) (HOLD)

EXEC RUN 'fffff1' ('fffff2') ('fffff3');
Interactive command.file generator.

TRACE — Allows debugging newly generated control files (command records are flagged by "+"; commands placed in MIF file .RUN are flagged by "-")

HOLD — Directs MIF generator program to generate the '.RUN' MIF file but does not execute it.

SET (input) (output)
Sets or changes PID and/or POD.

SET STATn
Establishes default station number, where n = 1, 2, 3, or 4.

SKIP (BACK) (n) [MTR1/MTR2]
Positions tape at the beginning of a file by skipping one or n number of files forward. If BACK specified, skips backward.

SN (value) (STATn) (output)
Places specified value in SN. If value not specified displays the contents of SN.

value — Any positive decimal integer from 1 to 9999.

SPLOT . . .
Analyzes go/no-go characteristics as a function of user selected tester units, and displays the results (to TTP or LP) as a SHMOO plot.

EXEC SPLOT (yunit, ystart, ystop, xunit, xstart, xstop, result, lstart, topt);

yunit — Scalar or array that defines tester unit to be varied on the SHMOO Y axis.

ystart, ystop — Start and stop values over which tester unit is varied for Y axis.

xunit, xstart, xstop — Same as above but for X axis.

result — Optional 96 word array returned by SPLOT to allow SHMOO results to be logged to a disk file for later processing by a FACTOR program.

lstart — Optional parameter to define test start address (default = 0)

topt — Optional parameter to select one of all available Enable Test forms for SPLOTs go/no-go testing:

100000B	Standard Enable Test.
100001B	EDGE mode test.
100002B	MATCH mode test.
100004B	AMATCH mode test.
100010B	LOOP option for MATCH mode test.
100020B	SEQUENTIAL MATCH mode test.
100040B	EXTERNAL SYNC test mode.
100100B	EXTERNAL ALTERNATE sync mode test.
100200B	HPG test. Do ENABLE PGEN 0,ON; first.
100400B	PPM test SET PPM ON; first.

Note

Bit 15 must always be set. If permitted by the system, more than one option may be enabled at one time by setting more than one bit in the control word.

Tester Unit Name vs Unit Number

E0 = 1	EC0 = 7	DPS1 = 11	PMU = 14
E1 = 2	EC1 = 8	DPS2 = 12	DCT = 15
EA0 = 3	S0 = 9	DPS3 = 13	TR = 16
EA1 = 4	S1 = 10	DPS4 = 69	ATR = 65
EB0 = 5	SA0 = 66	DPS5 = 70	RFC = 68
EB1 = 6	SA1 = 67	DPS6 = 71	

Sentry Timing Generators[1]

PD 1 = 17	APD 1 = 33	BPD 1 = 49
PD 2 = 18	APD 2 = 34	BPD 2 = 50
PD 3 = 19	APD 3 = 35	BPD 3 = 51
PD 4 = 20	APD 4 = 36	BPD 4 = 52
PD 5 = 21	APD 5 = 37	BPD 5 = 53
PD 6 = 22	APD 6 = 38	BPD 6 = 54
PD 7 = 23	APD 7 = 39	BPD 7 = 55
PD 8 = 24	APD 8 = 40	BPD 8 = 56

PW 1 = 25	APW 1 = 41	BPW 1 = 57
PW 2 = 26	APW 2 = 42	BPW 2 = 58
PW 3 = 27	APW 3 = 43	BPW 3 = 59
PW 4 = 28	APW 4 = 44	BPW 4 = 60
PW 5 = 29	APW 5 = 45	BPW 5 = 61
PW 6 = 30	APW 6 = 46	BPW 6 = 62
PW 7 = 31	APW 7 = 47	BPW 7 = 63
PW 8 = 32	APW 8 = 48	BPW 8 = 64

Enhanced Timing Module (ETM) Timing Generators[2]

TG1A START = 17	TG1B START = 33
TG2A START = 18	TG2B START = 34
TG3A START = 19	TG3B START = 35
TG4A START = 20	TG4B START = 36
TG5A START = 21	TG5B START = 37
TG6A START = 22	TG6B START = 38
TG7A START = 23	TG7B START = 39
TG8A START = 24	TG8B START = 40

TG1A STOP = 25	TG1B STOP = 41
TG2A STOP = 26	TG2B STOP = 42
TG3A STOP = 27	TG3B STOP = 43
TG4A STOP = 28	TG4B STOP = 44
TG5A STOP = 29	TG5B STOP = 45
TG6A STOP = 30	TG6B STOP = 46
TG7A STOP = 31	TG7B STOP = 47
TG8A STOP = 32	TG8B STOP = 48

1. APD/W and BPD/W on the Sentry VIII only, except APD/W4.

2. ETM unit numbers are the same as standard timing generators. For ETM timing value (TV) definition, the desired TV is batched with the desired x/y unit as follows: For unit 19, TV12, x/y unit = 1219.

SPLOT (STATn) (LP) (n) (EDGE) (functional test mode)

n	Local memory start address. Default = 0.	
EDGE	Invokes edge mode feature.	
functional test mode	NORMAL	Tests are in normal mode.
	MATCH	Match mode.
	AMATCH	Loop modifier for the match modes.
	LOOP	Loop modifier for the match modes.
	SEQUENTIAL	Match tests are in sequential mode.
	EXT	External sync is used.
	EXTA	External alternate sync mode is used.
	HPG	Enable Hardware Pattern Generator.
	PPM	Use the PPM instead of local memory for functional test.
	AGAIN	Repeats the conditions used the last time SPOT was accessed. SPLOT must have been loaded with KEEP option.

SWITCH (value) (output) (STATn)

Places specified value in SWITCH. If value not specified displays contents of SWITCH.

value	Decimal or octal integer, or floating point numbers.

TDX [MAKE/LOAD/MAKE M/LOAD M/LIST/INIT/VALL/VERIFY/CHECK/REV] (DRECT 1/n/L) (LP/TTP/VP1/VP2) (notes) (<command>/[command)] ((jjjj)) (PRFX 'prefix') ['ffffff'/SOURCE/OBJECT/DATA/COREIMAGE/ALL] (CTRL) (NOVER) (NOJOB) (OVLY) (CLEAR) (HOLD) (U) (MTR1/MTR2) (MTW1/MTW2)

File management tool for transferring groups of files between disk (or memory) and tape.

Warning

Do not use TDX when *any* other foreground or background operation is in progress.

MAKE/MAKE M	Write all specified files from disk or memory to tape.
LOAD/LOAD M	Load files from tape back to disk or memory.
LIST	List the specified directory.
INIT	Initialize a tape which is not currently a TDX tape.
'ffffff'	Name of the file(s) to be accessed.

SOURCE/DATA/OBJECT — Cause all source, object or data files to be accessed.

ALL — When preceded by a (job #) specification, all files under that job are accessed.

CTRL — Allow command options to be continued on the next line.

NOVER — Defeat automatic verification of files during a LOAD operation only.

NOJOB — Defeat writing of JOB records to tape during a MAKE operation. During a LOAD, permits files to be loaded into the current JOB, suppressing any JOB records written to the tape.

OVLY — Permit LOADed file to overlay any pre-existing file with the same name.

CLEAR — Delete files with names of those being loaded.

VALL — Create a MIF file '.VRALL' containing VERIFY records of all files under the specified job.

VERIFY — Verify the validity of files previously written to tape.

CHECK — Check that files on tape match those on disk.

DIRECT n/L — Specify directory to be made or loaded. L denotes "last" directory.

LP/TTP — Output device destination for LIST DIRECT function.

notes — Permit insertion of comments or notes into the directory. Notes must be enclosed by double quotes.

(jjjj) — Job number referenced by subsequent options. Must be enclosed in parentheses.

HOLD — TDX execution is terminated following the creation of the MIF file '.TDX'.

U — Suppress the use of blocking on a MAKE only.

/ / — Terminate the entry of keyboard commands or control records accepted by CTRL specification.

$$ — Equivalent to / / but required for TDX commands being executed from within the MIF file.

?? — Cause an abort to MASTR because of error in a control record.

<command> — Permit insertion of MASTR commands directly into the generated MIF file '.TDX. immediately prior to the SET TTK TTP END message. Commands must be enclosed by < >.

[command] — Allow insertion in TDX MAKE operation of MASTR commands for execution during a subsequent LOAD of the corresponding directory. Commands must be enclosed by [ ].

PRFX 'prefix' — MAKE or LOAD accepts all file names with a first character matching 'prefix.'

TE (n) (VP1/VP2/CLO/LP)
Displays n or all terminal error descriptions to specified output device. See Terminal Error Messages page 1-23.

TIME hh:mm
Sets system clock to specified hours and minutes.

Note
The clock timer is not incremented while in DOPSY.

TITLE 'string' (TOF) (STATn)
Allows output of text string for all output at station specified.

string	Maximum 64 character text string enclosed by single or double quotes.
TOF	Requests top of form on line printer output.
STATn	See parameter definitions.

TOF (n)
Causes one or n top of form to occur.

EXEC TTIME (tpass, tfail, start, stop, tgn, rslt, topt, tv);
Provides fast, convenient time measurement capability.

tpass	Passing pulse delay or width (pulse start or stop for ETM).
tfail	Failing pulse delay or width (pulse start or stop for ETM).
start	Local memory start address.
stop	Local memory stop address.
tgn	Timing generator manipulated during binary search.
rslt	Floating point time measurement result of search procedure.

topt	100000B	Standard ENABLE TEST.
	100001B	Enable the 'both' TG mode for Sentry VIII (120 pin system)
	100002B	MATCH mode test.
	100004B	AMATCH mode test.
	100010B	LOOP option for MATCH mode test.
	100020B	SEQUENTIAL MATCH mode test.
	100040B	EXTERNAL SYNC test mode.
	100100B	EXTERNAL ALTERNATE SYNC mode test.
	100200B	HPG test. Do ENABLE PGEN 0, ON; first.
	100400B	PPM test. Do SET PPM ON; first.
	101000B	With ETM allows the programmed pulse stop to remain constant when doing a search with pulse start.
tv	ETM TG timing value.	

TTIME Console Switch Options

CS1 Slows down each search step.

CS2 Defeats restoration of TGs on return, to allow examination by analysis commands.

CS3 Halts CPU within continuous loop mode. Used with CS1 to allow detailed scope observation of the scope at each position as it converges upon the final result.

CS4 Allows repeat of previous search.

CS6 Dumps (to station POD) timing values, delta and PASS/FAIL indications during binary search procedure. Values are integers in 80 ps units.

USE (input) (output) (STATn)
Changes station PID and POD used for FACTOR I/O and datalog output. NOTE: CLI is invalid input.

VAR variable-number (value) (STATn) (output)
Changes the value of a test program variable at a pause in test execution.

variable number Unique number is assigned by the compiler.

value Variable specified by variable-number is updated with this.

VERIFY 'ffffff' S/O/D/C/DV ((verify-number)) (MIF/DIF) (LP/TTP/VP2/VP1)
Checks the validity of a disk or memory resident source, object, data, or core image file.

(verify-number) An 8-digit octal number enclosed in parenthesis.
DV DATA variable length file.

EXEC VPLOT. . .
Allows point and vector plotting and cursor manipulation on the system VKT terminal. The forms are as follows:

EXEC VPLOT (0);
EXEC VPLOT (0,0);
Clears all characters from the screen; returns cursor to home position.

EXEC VPLOT (0,1);
Clears foreground only; returns cursor to home position.

EXEC VPLOT (0,2);
Clears the window, returns cursor to home position.

EXEC VPLOT (3);
EXEC VPLOT (3,0); Set Foreground
EXEC VPLOT (3,1); Set Background
Sets foreground or background.

EXEC VPLOT (4,x,y);
Moves the cursor to position X, Y.

EXEC VPLOT (6,char);
Writes ASCII.

EXEC VPLOT (6,xright,xleft,yupper,ylower);
Sets window.

EXEC VPLOT (7,xmax,xmin,ymax,ymin);
Sets scale.

EXEC VPLOT (8,x,y,char);
Plots point.

EXEC VPLOT (,x,y,char);
Plots vector.

WAIT
Prevents other operations while the foreground is running. If entered on the PID immediately after starting the tester, commands may be given via the PID but will not be executed until all foreground activity is terminated.

Caution
Inhibits a FACTOR READ (PID).

EXEC XGRAPH. . .
Allows test results and other data to be plotted graphically on line printer or VKT. The following six forms are available:

EXEC XGRAPH (op, x, tpas, ind);
Outputs SHMOO plot results from FACTOR program.

op = 10	Conventional SHMOO plots with Xs in SHMOO field.
= 11	Plot where SHMOO field contains TRASCII codes that the user has placed in the TPAS array.
x	Numerical value to be printed to the left of the SHMOO line on the vertical axis.
tpas	51 element array containing pass(1)/fail(0) pattern for current SHMOO line to be plotted.
ind = 0	Standard plot with every fifth location on the horizontal axis delineated by a column of periods, ('.').
= 3	Suppress printing of any X value (even 0) on the vertical axis and the '*' which follows it.
= 4	Suppress printing of columns of periods which delineate every fifth location on the horizontal axis.
= 5	Produces combined result of both 3 and 4.

EXEC XGRAPH (12,x, tpas, ind, tpasct, xrows);
Performs Composite SHMOO Plot.

x — Numerical value to be printed to the left of the SHMOO Line of the vertical (ordinate) axis.

tpas — 51 word array containing the pass (1)/fail(0) pattern to be composited upon the previously collected data.

ind = 1 — Overlay the current pass/fail pattern in TPAS upon area of previously collected data specified by TPASCT.

 = 2 — Output a line of composited SHMOO data according to area of data specified by TPASCT.

 = 20 — Clear contents of internal memory buffer and file specified by TPASCT.

tpasct = 00 to 9 — Two digit number used as last 2 characters of file name during open and clear function, or a number (50 to 2500) in increments of 50 during compositing and printing composite results.

xrows = 1 to 50 — Determines the number of rows or lines of SHMOO data that are composited and printed along the x (vertical) axis.

EXEC XGRAPH (op, x, y);
Performs X-Y plots and bar graphs:

op = 1 — For X=Y plots, where X is printed on plot at location X, T.

 = 2 — Block graphs, where a row of Xs of length Y is printed at location X.

x — X axis coordinate (printed on left hand margin of plot). A constant, variable, or expression. See description of Y.

y — Y axis coordinate that must be normalized to a value between YMIN and YMAX. A constant, variable, or expression.

EXEC XGRAPH (0);
Perform line printer top of form:

EXEC XGRAPH (3,loc,val,ind);
Uses XGRAPHS internal buffer for auxiliary data storage by the FACTOR program:

loc — Buffer address (0 to 1250) to be accessed.
val — Data fetched from or stored in buffer location LOC.
ind = 0 — Place VAL in buffer location LOC.
= 1 — Returns data from buffer location LOC to VAL.

XMIT

EXEC XMIT;
Dumps the foreground contents of the VKT screen to the line printer.

3 MASTR Factor Programming Language

Parameter Definitions

[array]	Must be declared before used. Brackets required to designate array size.
binary-pin-pattern	Each bit of the pattern specified or the following operators: [n] Pin original operator, where n is an integer. (m:bpp) Binary pin pattern replicator, where m is an integer and bpp is binary pin pattern.
decimal-pin-list	One or more decimal pin numbers separated by blanks or commas. A sequential group of pins can be separated with the start pin numbers and end pin numbers separated by a dash.
expression	Any floating point number, variable, or arithmetic combination of numbers and variables.
integer	User must select appropriate number or expression.
LOG	Allows datalog measurements specified with LOG.
number	Any floating point number but may not be a variable.
statement	May be a single statement, or a compound statement designated by BEGIN. . .END.
pin-list	List of pins (separated by spaces or commas) that may be connected to a device.

Arithmetic/Boolean/Relational Operators

Symbol	Operation	Precedence Value
NEG	Unary negate	1 (highest precedence)
NOT	Not	
↑	Exponentiation	2
/	Division	3
*	Multiplication	
+	Addition	4
−	Subtraction	
LT	Less than	
LEQ	Less than or equal	
EQ	Equal to	5
GE	Greater than or equal	
GT	Greater than	
NEQ	Not equal	
AND	Logical and	6
EOR	Exclusive or	
OR	Inclusive or	7 (lowest precedence)

Globals

DATALOG Used to control datalog requests.

GLOB1-40 Global values for user data storage or conditional branching.

RTD Round trip delay to support ETM option. Not to be altered.

SN Serial number of devices being tested. Initialized to 1.

SWITCH Used for conditional branch operations.

TT Test type.

VALUE Contains last value obtained from MEASURE statement execution.

Reserved Words

AND
ASSIGN
AT
BEGIN
BLOCK
BRANCH
BY
CALL
CGEN
CLEAR
CONN
CPMU
DCL
DISABLE
DO
ELSE
ENABLE
END
ENDC
ENDM
EOR
EQ
EXEC
FOR
FORCE
FUNCT
GE
GOTO
GET
IF
IFC
INSERT
LCGEN
LEQ
LSET
LSUBR
LT
MACRO
MEASURE
NEG
NEQ
NOISE
NOT
ON
OR
PAUSE
PGEN
PGM
RD
READ
REM
RESET
REXEC
SET
SPEC
SUBR
THEN
THRU
UPDATE
WR
WRITE
XCON
XPMU

Factor Statement Forms

AT [label/label ± expression/expression];
Designates a local memory address at which modifications are desired.

BLOCK. . .END;
Allows grouping of program statements. Nesting is legal up to 8 levels. Local variable storage and local labels cannot be referenced outside the parent block.

CALL identifier (expression1, expression2, . . ., expression n);
Executes subroutine specified and returns control to the calling routine.

CGEN [TG0/TG1/TG2/TG3/TG4/TG5/TG6/TG12] decimal-pin-list;
Connects listed pin(s) to specified timing generator.

TG0	Reference time T0.
TG1-6	Functional testing data and clock timing.
TG12	Logical OR of TG1, TG2 for double pulse

CLEAR [DCT/FCT/TRIP/RESET];
Cancels the effect of a previously executed ON FCT/DCT/TRIP or ON RESET CALL statement.

CLEAR FAIL [FCT/DCT/TRIP] (,FCT/,DCT/,TRIP);
Clears the system software fail flags.

CONN [CLK/DPS1/DPS2/DPS3/TCOM] decimal-pin-list;
Defines the listed pins as clock pins or connects them to specified power supply or tester common via the PE card.

CPMU PIN expression;
Connects the PMU to pin specified.

DCL identifier ([array-size]) (/value-list/) . . . ;
Single or arrayed (one dimensional)variable declaration to reserve storage for variables, assign initial values, or make a variable local to the block in which it is declared.

[array-size] Size of array, if identifier specified as array variable.
/value-list/ Initial value of identifier, or values if identifier is an array.

DISABLE TRIPS;
Clears all voltage and current trip limits set up with ENABLE.

ENABLE ACCESS;
Forces a disk access to reload memory buffer if test program does not fit.

ENABLE [DA/DB/MA/MB] (DA/DB/MA/MB);
Selects I/O definition register and/or pin mask register to be used. If not programmed DA and MA are enabled by default.

ENABLE [DCT0/DCT1] [LT/GT] expression;
DISABLE [DCT0/DCT1];
Forms a PMU software pass-fail threshold; or if both DCT0 and DCT1 specified (in separate statements) forms a pass-fail window for subsequent DC measurements (see MEASURE VARIABLE and MEASURE VALUE). DISABLE disables comparison limits and inhibits dc fail.

[ENABLE/DISABLE] DOUBLE STROBE;
Allows pins indicated by 0 in SET STROBE to be strobed by both TG and TG8.

ENABLE [ILO/IHI/VLO/VHI] [GT/LT] number;
Enables software limit comparisons to be made on all programmed current/voltage operands prior to statement execution.

[ENABLE/DISABLE] IMASK;
Provides automatic masking of comparators on all input pins.

[ENABLE/DISABLE] LATCHES;
Determines if C register is to be cleared prior to strobing functional test comparators.

[ENABLE/DISABLE] MUXMODE;
Enables the logical OR of functional forcing gate: pin 16 ORed with pin 1, pin 1 driver surviving (17 ORed with 2, etc.); first 8 pins of rank 1 ORed with first 8 of rank 2; first 8 pins of rank 3 ORed with first 8 of rank 4.

ENABLE PPM;
Causes the current microprogram in the control RAM to be executed once, if SET PPM ON is active.

[ENABLE/DISABLE] RELAY;
Allows pin electronics voltage conditioner to remain connected to a pin when the PMU is connected.

[ENABLE/DISABLE] RTO;
Inverts the entire waveform produced when RZ mode and INVERTED data have been programmed for a particular pin.

[ENABLE/DISABLE] SPLIT;
Allows selection of the alternate test rate and timing generator during PPM RAM testing.

ENABLE TEST (test-mode);
Determines test mode and initiates execution of test program loaded into local memory. Test modes are as follows:

NORMAL — Between test start/end addresses. Default case.

IFAIL — Functional fails ignored until IFAIL address or count reached.

EXT/EXTA — System test rate generator replaced with DUTs internal clock acting as a sync for starting functional test and timing generators.

MATCH/AMATCH — In minor loop or SPM match loop until pass occurs.

CONTINUOUS — In minor loop or SPM continuous loop until mode changed.

MOMENTARY — User may exit CONTINUOUS mode.

IMMEDIATE — Compiler directive to produce DMA code instead of interpretive. DMA has the least overhead, but no fail time-out protection provided.

ENABLE [TRIPI1/TRIPI2/TRIPI3] [LT/GT] expression (,RNG2/,RNG3);
Enables current-trip detector of the corresponding voltage forcing unit. Auto-ranging or see table 3-1.

ENABLE [TRIPV1/TRIPV2/TRIPV3] [LT/GT] expression (,RNG2/,RNG3);
Enables voltage-trip detector of the corresponding DPS current forcing unit. Auto-ranging or see table 3-1.

END;
Closes BEGIN, BLOCK, FUNCT, SUBR, or a FACTOR String file.

ENDC;
Defines end of conditional compile (See IFC).

ENDM;
Defines end of macro definition (See MACRO)

EXEC ffffff (parameter1, parameter2, . . . , parameter 63);
Executes an assembly language program.

ffffff FACTOR identifier which is also the name of a coreimage file on disk or in memory.

parameter Global variable, variable, array name, array element, or expression.

FOR variable=expression THRU expression BY increment DO statement;
Allows looping under control of a variable.

FORCE CURRENT expression (,RNG0/,RNG1/,RNG2,/RNG3);
Forces PMU to current specified. RNG3 default or see table 3-1.

FORCE DELAY;
Forces the time delay to occur and to wait until tester is not busy.

FORCE [E0/E1/EA0/EA1/EB0/EB1/EC0/EC1] expression (,RNG1/,RNG2/,RNG3);
Forces voltage conditioner reference supplies to programmed value. Auto-ranging or see table 3-1.

FORCE [IF1/IF2/IF3] expression (,RNG2/,RNG3);
Forces specified currents via programmable power supplies. Auto-ranging or see table 3-1.

FORCE PMU expression;
Forces output of PMU to value specified in the mode and range specified by a prior SET PMU statement.

FORCE RESET;
Clears all programmable test conditions and causes a hardware reset.

FORCE [VF1/VF2/VF3/VF4/VF5/VF6] expression (,RNG1/,RNG2/,RNG3);
Forces DPS voltage supply to value specified. Auto-ranging or see table 3-1.

FORCE VOLTAGE expression (,RNG1/,RNG2/,RNG3/,RNG4);
Forces PMU to voltage specified. RNG3 default or see table 3-1.

FORCE WAIT;
Forces tester to wait until "tester not-busy" before processing the next statement.

FUNCT identifier (parameters);
Begins a function terminating with END. The identifier is used in expressions to cause execution of the function's statements and use of the value returned by the function.

GOTO label;
Causes unconditional branch.

GOTO (label1, label2, . . . , labeln) expression;
Branch to appropriate label if expression rounds off to a value 1 ≤ value ≤ n else no branch.

IF [relation/boolean expression] THEN statement;
IF [relation/boolean expression] THEN BEGIN . . . END;
IF [relation/boolean expression] THEN statement1 ELSE statement2;
Statements are executed if the IF condition is met. Third form executes Statement 2 if condition is not met.

IFC Cn EQ [0/1] THEN statement;
IFC Cn EQ [0/1] THEN BEGIN (statements) ENDC;
When used with COMPILE options, causes conditional compilation of a single statement or statements 1 through n terminated by ENDC.

INSERT string-file-name;
Allows inclusion and compilation of the named source file at point specified.

LABEL:
An address is assigned to label to allow branching to label.

LABEL@
Designates a local memory address label. Must be defined before reference and must not be used as objects of GOTO or ON FCT statements.

LCGEN TGx decimal-pin-list;
Assigns timing generators from local memory. Special timing considerations and pipeline compensation required.

[LIST/NOLIST];
Controls compiler listing.

LSET [DA/DB] (*) binary-pattern;
Sets I/O pin definition register from local memory during functional testing.

LSET [I/INVERT] (*) binary-pattern;
Same as SET I/INVERT except invert register written from local memory.

LSET IX (*) binary-pattern (,binary-pattern, . . .);
Inverts and then executes the F-data from the last SET F statement. Inverts remain active until SET I, LSET I, or LSET IX redefine them.

LSET IX (*) binary-pattern—LCALL identifier;
Causes inversion of F-data and execution followed by a call to local memory subroutine.

LSET [MA/MB] (*) binary-pattern;
Sets pin mask register from local memory.

LSET [RZ/XOR/STROBE/ST] (*) binary-pattern;
Allows loading of long register from local memory. Special timing considerations and pipeline compensation required.

LSUBR identifier (NORMAL/MATCH) integer;
LSUBR identifier CONTIN
Defines loop start address, number of times of loop execution, and the test mode for local memory subroutine loops.

MACRO name;
Begins definition of user defined macro, terminated by ENDM.

MEASURE NODE number (,LOG);
Causes the PMU to measure DPS voltage or current or RVS voltage at an internal tester monitor node. (See table 3-2.)

MEASURE PIN;
Allows fast go/no-go dc parameter tests. Similar to MEASURE VALUE except comparisons are made against SET DCT limit and no floating point conversion takes place. Cannot be used in CONTINUOUS mode.

MEASURE PIN number (,LOG);
Initiates dc measurement sequence for SET TEST.

MEASURE VALUE (,LOG);
Initiates a measurement within the PMU and stores the resulting value in the system global VALUE. Compares VALUE with Enable DCT1/0 limits.

MEASURE VARIABLE variable (,LOG);
Stores the value of the specified variable identifier or array element in the system global VALUE. Compares VALUE with Enable DCT1/0 limits.

NOISE word1 (,word2, . . . , wordn);
Defines words (ignored by compiler) that make statements read like English sentences. Reserved words and user declared identifiers not allowed.

ON [DCT/FCT/TRIP], label;
Cause a program branch to label on failures.

ON [DCT/FCT/TRIP] CALL subroutine-name;
Calls subroutine on failure.

ON [DIFEOF/EOF] label;
Used with READ statement to cause program branch to label when disk or other EOF (end of file) is read.

ON RESET CALL subroutine-name;
Branches to subroutine on encounter of FORCE RESET statement, normal EOT terminal error or RESET button pressed.

PAGE (text);
Moves paper to top of form if listing. is to line printer.

text	Any alphanumeric or special character except a semicolon.

PAUSE expression;
Program pauses until START button is pressed. Value of expression output to the POD.

READ [(CR)/(CLI)/(TTK)/(VK1)/(VK2)/(PID)] [v1/&v1];
READ [(MTR)/(MTR1)/(MTR2)/(MIF)/(DIF)] "char" [v1/&v1];
Reads data from specified device and assigns to variables.

Note

1. Parenthesis required around device mnemonic
2. Not all data types applicable to every peripheral device.

"char"	File identifier.
v1	Numerical variable or arrayed numerical variable.
& v1	Literal variable or arrayed literal variable.

READ EIR variable;
Reads EIR register.

READ (AxxxB) variable;
Reads short register. (See table 3-3.)

READ (xxxB) variable;
READ (xxxxB L) variable;
Reads long register. (See table 3-4.)

REM (text);
Allows comments to be placed in FACTOR program.

text   Any alphanumeric or special character except a semicolon.

RESET [DIF/IFILE];
Resets file pointer to the beginning of disk or memory file and reopens the file.

REXEC ffffff (parameter1, . . . , parameter13);
Causes the load and execution of a PPM microprogram.

ffffff   Maximum 6 characters and a value (module number) in parameter1. Module number may be a constant or a variable.

Parameter	**Function**		
1	module number	8	X1 HOLD
2	XMAX	9	Y1 HOLD
3	YMAX	10	X2 HOLD
4	TREF	11	Y2 HOLD
5	CS	12	X3 HOLD
6	MASKX	13	Y3 HOLD
7	MASKY		

SET CHAIN [TWO/FOUR] surviving-pin-list;
SET CHAIN OFF;
Allows 2 or 4 test patterns to be generated for each SET F statement. Not allowed with SPM. (See table 3-6 for surviving pin list.)

SET CLAMP [SYM/POS/NEG] number;
SET CLAMP OFF;
Sets limit on voltage allowed when PMU current is forced.

POS	No voltages less than −0.7.
NEG	No voltages greater than 0.7.
SYM	Both positive and negative voltages.

SET CRO (*) binary-pin-pattern;
Opens comparator relays as defined by binary pin pattern.

Standard for high speed station only.

1	Opens relay.
0	Closes relay, except when PMU is on the pin.

SET [DA/DB] (*) binary-pin-pattern;
Sets either the primary or alternate I/O pin definition register. 1 defines input pin; 0 defines output pin.

SET DCT [LT/GT] expression (,RNG0/,RNG1/,RNG2/,RNG3/,RNG4);
Forms hardware pass/fail limit for DCT threshold for MEASURE PIN.

SET DELAY expression, DC;
Loads value into the tester time delay register.

SET F (*) binary-pin-pattern (,binary-pin-pattern, . . .);
Loads functional test pattern into local memory.

SET F (*) binary-pattern—LCALL identifier;
Causes a call to the loop (local memory subroutine) specified.

SET F (*) binary-pattern—LEND;
Defines the end of a subroutine.

SET F (*) binary-pattern—LGOTO label/integer;
Allows unconditional branching in local memory.

SET FC CONTIN (*) binary-pattern;
SET FC (NORMAL/MATCH) integer (*) binary-pattern;
Loads a binary functional test pattern into local memory and arms a clock burst so the pattern is repeated. In CONTINUOUS mode the pattern is repeated until execution of ENABLE TEST MOMENTARY. In NORMAL mode the pattern is repeated "integer" number of times. In MATCH mode the pattern executes until MATCH occurs. if MATCH LOOP is specified, the nth iteration of SET FC MATCH n forces a failure.

Two consecutive SET FC CONTIN statements are not allowed.

SET FI binary-pin pattern;
Modifies one or more bits of data at a local memory address location.

SET IFAIL [label/expression/label ±expression];
SET IFAIL expression, COUNT;
Sets local memory address or step count through which fails are ignored.

SET [INVERT/I] (*) binary-pin-pattern;
Provides the ability to invert (1) or not invert (0) the F-data for selected pins.

SET [IOMODE/IOM3] [OFF/surviving-pin-list];
Allows selection of tester pins to provide I/O definition of each SET F independent of DA/DB definition. (See table 3-6 for surviving pin list.)

SET LOGIC [POS/NEG];
Initializes functional test comparator for either positive or negative logic.

SET [MA/MB] (*) binary-pin-pattern;
Sets either primary or alternate I/O pin mask register. 1 defines care; 0 defines don't care.

SET MAJOR expression [,label/,label ±expression/, expression];
SET MAJOR n,l;
Defines the major loop within local memory.

n	Major loop count (1 <N <4096)
l	Major loop end address

SET MINOR expression ([,label/expression/,label ±expression] [,label/. . . expression]);
SET MINOR m (,j,k);
Defines the minor loop within local memory. Not allowed with SPM.

m	Minor loop count (1 <M <4096). Default=1 and removes minor loop.
j	Minor loop start address.
k	Minor loop end address.

SET MPIN number;
Defines maximum pin count allowed.

SET PAGE integer (,SPM) (,HS);
Indicates to compiler and MASTR that program contains tester statements; specifies size of a local memory load; and selects SPM and high speed station options.

SET [PERIOD/APERIOD] expression (,RNG0/,RNG1/,RNG2/,RNG3);
Defines functional test rate prior to ENABLE TEST, or defines alternate functional test rate for read test cycle during execution of a PPM microprogram. Auto-ranging or see table 3-7.

SET PMU [SENSE/FORCEV/FORCEI] [(,RNG0/,RNG1/,RNG2/,RNG3/,RNG4/,AUTO)];
Initializes PMU. Auto-ranging option or see table 3-1.

SET PPM [ON/OFF];
Allows the ENABLE PPM statement to start the pattern processor. Should be turned OFF when not in use.

SET Q binary-pattern;
Loads Q and QL registers prior to a test sequence initiated in MATCH or AMATCH mode (12 bits maximum length).

SET R (*) binary-pin-pattern;

Controls the opening or closing of load board utility relays.

1 Closes relay.
2 Opens relay.

SET REG n (,n,n, . . . n);

Inserts user defined data code, bypassing compiler code generation. Optional parameter n contains eight octal digits.

CAUTION
Use with care. No error checking is done by compiler.

SET REL 'xxxx';

Assigns test plan release number and displays in the VERIFY output record.

'xxxx' any 4 legal TRASCII characters (i.e. '1.0' or '2.1B').

SET RZ (*) binary-pin-pattern;

Programs any tester pin to either Return-to-Zero or Non-Return-to-Zero mode.

1 RZ mode (normal condition for clock pins).
0 NRZ mode (normal condition for data pins).

SET S (*) binary-pin-pattern;

Loads the S register with selected alternate reference supplies.

0	Data pins: E1/E0,	S0/S1	Clock Pins: EA0/EA1
1	Data pins: EB1/EB0	SA0/SA1	Clock Pins: EC0/EC1 (SA0/SA1)

SET SI binary-pin-pattern;

Similar to SET S except generates interpretive code to modify the S register.

SET [S0/S1/SA0/SA1] expression (,RNG1/,RNG2/,RNG3);

Sets reference supplies to value specified. Auto-ranging or see table 3-1.

SET [STROBE/ST] (*) binary-pin-pattern;
Selects one or both of two possible strobe times for each tester pin.

0	Connects TG7 to the pin.
1	Connects TG8 to the pin.

SET START [label/expression/label ± expression];
Specifies the start address for the next functional test execution. Default is LM location 0.

SET TEST [1/2/3/4/5/6/7/9/10];
When immediately preceded with a set up procedure, provides a macro definition for performing a particular type of dc measurement. The dc measurement sequence is then initiated with the statement: MEASURE PIN number;

1 = VOH	4 = ICEX	7 = ISC
2 = VOL	5 = IIL (FX)	9 = IOL
3 = IIH (IR)	6 = VCD	10 = VBD

SET [TGx/ATGx/BTGx] [DELAY/WIDTH] expression (,RNG0/,RNG1/,RNG2/,RNG3);
Sets delay and width of timing generators 1 to 8 (lower 60 pins), or alternate TGs (upper 60 pins), or both. Auto-ranging or see table 3-7.

TGx	Lower 60 pins
ATGx	Upper 60 pins (SENTRY VIII).
BTGx	TGx and ATGx set to same value.

SET TIMEOUT expression;
Sets a time-out of local memory tests when ENABLE TEST MATCH or EXT options used. If not programmed the value in SET DELAY expression, DC; is used.

SET VOFFSET number;
Defines voltage offset value to be added to all subsequent voltage or sensing statements. Does not apply to SET CLAMP.

SET XOR (*) binary-pin pattern;
Establishes exclusive NOR condition of F-data and the timing generator assigned to the pin.

SUBR identifier ((parameters . . .));
Begins a subroutine terminating with END. The identifier must be used in call statements to specify the execution of the subroutine.

variable = expression;
Assigns value of the expression to the variable.

WRITE [(LP)/(TTP)/(VP1)/(VP2)/(POD)] data (,data, . . .);
WRITE [(MTW)/(MTW1)/(MTW2)/(DOF)/(MOF)/(CLO)] "char" data (,data,...);
Write data from variables to specified device.

Notes

1. Parenthesis required around device mnemonic
2. Not all data types apply to every peripheral device

"char" Filename identifier.
data May be:
Numeric variable (e.g. V) or array.
String of characters in single quotes (e.g. 'ccc').
Any of above preceded by column number enclosed in slashes (e.g. /10/V)

WRITE (EIR) expression;
Writes to the EIR register.

WRITE (AxxxB) expression;
Writes to short register. (See table 3-3.)

WRITE (xxxB) expression;
WRITE (xxxxB L) expression;
Writes to long register. (See table 3-4.)

XCON PIN decimal-pin-list;
Disconnects power or clock pin and reconnects pin to selecteddata reference.

XCON [VF1/VF2/VF3];
Disconnects specified DPS unit from the load board (when using direct load board connection).

XPMU PIN;
Disconnects PMU.

Table 3-1 Force/Measure Ranges

DPS Force VF/Enable TRIPV

Range Number	Voltage Range	Resolution
1[1]	±2.046 V	2 mV
2	±10.23 V	10 mV
3	±40.92 V	40 mV

DPS Force IF/Enable TRIPI

Range Number	Current Range	Resolution
2	±102.3 mA	0.1 mA
3	±1.023 A	1 mA

PMU Force Voltage/Sense Voltage

Range Number	Voltage Range	Resolution
1[2]	±2.046 V	2 mV
1	±1.023 V	1 mV
2	±10.23 V	10 mV
3	±40.92 V	40 mV
4	±102.3 V	100 mV

PMU Force Current/Sense Current

Range Number	Current Range	Resolution
0	±1.023 μA	1 nA
1	±0.1023 mA	0.1 μA
2	±10.23 mA	10 μA
3	±102.3 mA	100 μA

RVS Set/Force E

Range Number	Voltage Range	Resolution
1[2]	±2.046 V	2 mV
2[3]	±10.23 V	10 mV
3[3]	±30.72 V	40 mV

[1] Valid with 2V/2mV option for Force VF only.

[2] Valid for 2V/2mV option only.

[3] Subject to limit of pin electronics type.

Table 3-2 Internal Nodes Measurement

Node Number			Measured Parameter
Decimal	Octal	Name	Description
128	200	S1	Comparator S1 Ref. Voltage
129	201	S0	Comparator S0 Ref. Voltage
130	202	E1	Forcing Level E1 Ref. Voltage
131	203	E0	Forcing Level E0 Ref. Voltage
132	204	EA1	Forcing Level EA1 Ref. Voltage
133	205	EA0	Forcing Level EA0 Ref. Voltage
134	206	EB1	Forcing Level EB1 Ref. Voltage
135	207	EB0	Forcing Level EB0 Ref. Voltage
136	210	EC1	Forcing Level EC1 Ref. Voltage
137	211	EC0	Forcing Level EC0 Ref. Voltage
138	212	SA1	Comparator SA1 Ref. Voltage
139	213	SA0	Comparator SA0 Ref. Voltage
140	214	VF1	Voltage Forcing Unit 1 Output Vol.
141	215	VF2	Voltage Forcing Unit 2 Output Vol.
142	216	VF3	Voltage Forcing Unit 3 Output Vol.
143	217	TRIP1	VF1 Load Current
144	220	TRIP2	VF2 Load Current
145	221	TRIP3	VF3 Load Current

Table 3-3 Short Register Read/Write Codes

Statement Format: [READ/WRITE] (AxxxB) [variable/expression];
A = 1 = SPECIAL
A = 2 = WRITE
A = 3 = READ

Reg. No.	Register	A x x x	Special Function
0	No-op		
1	MODE	A 0 0 2	Clear Mode Reg
2	STATUS	A 0 0 4	Clear Status Reg
3	Instruction	A 0 0 6	
4	Memory Address	A 0 1 0	
5	TSC	A 0 1 2	
10	Clock Burst Count	A 0 2 0	
11	Time Delay	A 0 2 2	Start dc Delay
14	Instruction Number Compare	A 0 3 0	
15	Instruction Number Display	A 0 3 2	
21	DPS1	A 0 4 2	Disconnect DPS1
22	DPS2	A 0 4 4	Disconnect DPS2
23	DPT3	A 0 4 6	
24	DPS3	A 0 5 0	Disconnect DPS3
25	DPT2	A 0 5 2	
26	DPT1	A 0 5 4	
32	E1	A 0 6 4	
33	E0	A 0 6 6	
34	S1	A 0 7 0	
35	S0	A 0 7 2	
36	EA1	A 0 7 4	
37	EA0	A 0 7 6	
42	EB1	A 1 0 4	
43	EB0	A 1 0 6	
44	EC1	A 1 1 0	
45	EC0	A 1 1 2	
46	SA1	A 1 1 4	
47	SA0	A 1 1 6	

Table 3-4 Long Register Read/Write Codes

Statement Format: [READ/WRITE] (xxxB) [variable/expression];
(for 3 digit codes)
[READ/WRITE] (xxxxB L) [variable/expression];
(for 4 digit codes)

Register	(Pins)	Register No.	Write	Read
RZ	1 to 15	000	200	400
RZ	16 to 30	001	201	401
RZ	31 to 45	002	202	402
RZ	46 to 60	003	203	403
RZ	61 to 75	004	204	404
RZ	76 to 90	005	205	405
RZ	91 to 105	006	206	406
RZ	106 to 120	007	207	407
ST	1 to 15	010	210	410
ST	16 to 30	011	211	411
ST	31 to 45	012	212	412
ST	46 to 60	013	213	413
ST	61 to 75	014	214	414
ST	76 to 90	015	215	415
ST	91 to 105	016	216	416
ST	106 to 120	017	217	417
D/DA	1 to 15	020	220	420
D/DA	16 to 30	021	221	421
D/DA	31 to 45	022	222	422
D/DA	46 to 60	023	223	423
D/DA	61 to 75	024	224	424
D/DA	76 to 90	025	225	425
D/DA	91 to 105	026	226	426
D/DA	106 to 120	027	227	427
DB	1 to 15	030	230	430
DB	16 to 30	031	231	431
DB	31 to 45	032	232	432
DB	46 to 60	033	233	433
DB	61 to 75	034	234	434
DB	76 to 90	035	235	435
DB	91 to 105	036	236	436
DB	106 to 120	037	237	437

Table 3-4 Long Register Read/Write Codes (Continued)

Register	(Pins)	Register No.	Write	Read
M/MA	1 to 15	040	240	440
M/MA	16 to 30	041	241	441
M/MA	31 to 45	042	242	442
M/MA	46 to 60	043	243	443
M/MA	61 to 75	044	244	444
M/MA	76 to 90	045	245	445
M/MA	91 to 105	046	246	446
M/MA	106 to 120	047	247	447
MB	1 to 15	050	250	450
MB	16 to 30	051	251	451
MB	31 to 45	052	252	452
MB	46 to 60	053	253	453
MB	61 to 75	054	254	454
MB	76 to 90	055	255	455
MB	91 to 105	056	256	456
MB	106 to 120	057	257	457
F	1 to 15	060 (070)	260 (270)	460
F	16 to 30	061 (071)	261 (271)	461
F	31 to 45	062	262	462
F	46 to 60	063	263	463
F	61 to 75	064	264	464
F	76 to 90	065	265	465
F	91 to 105	066	266	466
F	106 to 120	067	267	467

F register Rank 1, Bit 18 = 1 Sets DB register selection
Bit 18 = 0 Sets DA register selection
F register Rank 2, Bit 18 = 1 Sets MB register selection
Bit 18 = 0 Sets MA register selection

Register	(Pins)	Register No.	Write	Read
S	1 to 15	100	300	500
S	16 to 30	101	301	501
S	31 to 45	102	302	502
S	46 to 60	103	303	503
S	61 to 75	104	304	504
S	76 to 90	105	305	505
S	91 to 105	106	306	506
S	106 to 120	107	307	507

Table 3-4 Long Register Read/Write Codes (Continued)

Register	(Pins)	Register No.	Write	Read
TGA0	1 to 15	110	310	510
TGA0	16 to 30	111	311	511
TGA0	31 to 45	112	312	512
TGA0	46 to 60	113	313	513
TGA0	61 to 75	114	3x4	514
TGA0	76 to 90	115	315	515
TGA0	91 to 105	116	316	516
TGA0	106 to 120	117	317	517
C/INVERT	1 to 15	120	320	520
C/INVERT	16 to 30	121	321	521
C/INVERT	31 to 45	122	322	522
C/INVERT	46 to 60	123	323	523
C/INVERT	61 to 75	124	324	524
C/INVERT	76 to 90	125	325	525
C/INVERT	91 to 105	126	326	526
C/INVERT	106 to 120	127	327	527

Note
READ: C Register/Write: Invert Register

TGA1	1 to 15	130	330	530
TGA1	16 to 30	131	331	531
TGA1	31 to 45	132	332	532
TGA1	46 to 60	133	333	533
TGA1	61 to 75	134	334	534
TGA1	76 to 90	135	335	535
TGA1	91 to 105	136	336	536
TGA1	106 to 120	137	337	537
R	1 to 15	140	340	540
R	16 to 30	141	341	541
R	31 to 45	142	342	542
R	46 to 60	143	343	543
R	61 to 75	144	344	544
R	76 to 90	145	345	545
R	91 to 105	146	346	546
R	106 to 120	147	347	547

Table 3-4 Long Register Read/Write (Continued)

Register	(Pins)	Register No.	Write	Read
TGA2	1 to 15	150	250	550
TGA2	16 to 30	151	251	551
TGA2	31 to 45	152	252	552
TGA2	46 to 60	153	253	553
TGA2	61 to 75	154	254	554
TGA2	76 to 90	155	255	555
TGA2	91 to 105	156	256	556
TGA2	1p6 to 120	157	257	557
Pin Address		160	360	560
Statement Number Display		162	362	562
Test Rate		163	363	563
Precision Power Source		164	364	564
Precision Sense Level		165	365	565
External Interface Register		166	366	566
Slave Test Station Control		167	367	567
Test Start/Delayed Memory Address		170	370	570

READ: Delayed Memory Address/WRITE: Test Start.

Minor Loop Count	1701	1701	1701
Major Loop Count	1702	1702	1702
Main Frame Access	1703	1703	1703
Minor Loop Start Address	1704	1704	1704
Minor Loop End Address	1705	1705	1705
Major Loop End Address	1706	1706	1706
Ignore Fail	1707	1707	1707
DC Trip	171	371	571
Chaining	172	372	572
Status Mode A	173	373	573
Status Mode B	1734	1734	1734
Status Mode C	1735	1735	1735
Status Mode D	1736	1736	1736
Status Mode E	1737	1737	1737

Table 3-4 Long Register Read/Write Codes (Continued)

Register	Register No.	Write	Read
Pulse Width TG1	1751	1751	1751
Pulse Width TG2	1752	1752	1752
Pulse Width TG3	1753	1753	1753
Pulse Width TG4	1754	1754	1754
Pulse Width TG5	1755	1755	1755
Pulse Width TG6	1756	1756	1756
Pulse Width TG7	1757	1757	1757
Pulse Width TG8	175	375	575
Pulse Delay TG1	1761	1761	1761
Pulse Delay TG2	1762	1762	1762
Pulse Delay TG3	1763	1763	1763
Pulse Delay TG4	1764	1764	1764
Pulse Delay TG5	1765	1765	1765
Pulse Delay TG6	1766	1766	1766
Pulse Delay TG7	1767	1767	1767
Pulse Delay TG8	176	376	576
Power Pin Address	177	377	577
Timing Generator Vernier	17704	Cannot be read/written from FACTOR.	

Table 3-5 Alternate Bank Log Register (LRAX = 1) Read/Write Codes

Register	(Pins)	Register No.	Write	Read
XOR	1 to 15	000	200	NA
XOR	16 to 30	001	201	NA
XOR	31 to 45	002	202	NA
XOR	46 to 60	003	203	NA
XOR	61 to 75	004	204	NA
XOR	76 to 90	005	205	NA
XOR	91 to 1p5	006	206	NA
XOR	106 to 120	007	207	NA
CRO	1 to 15	020	220	420
CRO	16 to 30	021	221	421
CRO	31 to 45	022	222	422
CRO	46 to 60	023	223	423
CRO	61 to 75	024	224	424
CRO	76 to 90	025	225	425
CRO	91 to 105	026	226	426
CRO	106 to 120	027	227	427
Data Readout 1		060	NA	460
Data Readout 2		062	NA	462
Topological Scrambler		100	300	500
Hold Register 1		102	302	NA
Index Register 1		102	NA	502
Hold Register 2		104	304	NA
Index Register 2		104	NA	504
Hold Register 3		106	306	NA
Index Register 3		106	NA	506
Maximum Register		110	310	NA
Compare Address Register		110	NA	510
Delta Register 1		112	312	NA
Delta Register 2		114	314	NA
Delta Register 3		116	316	NA
Control RAM 1		120	320	520
Control RAM 2		122	322	522
Control RAM		124	324	524
Shift Data		126	326	NA
Execute Address		126	NA	526

Table 3-5 Alternate Bank Long Register (LRAX=1) Read/Write Codes (Continued)

Register	Register No.	Write	Read
Data RAM	130	330	530
Chip Select and Mask	132	332	NA
Stop and Storage Address	134	334	534
Refresh Count	136	336	NA
Start Address	1700	NA	2100
Return Address	1701	NA	2101
Clock Burst	1703	NA	2103
Loop Count Stack	1704	NA	2104
Loop Count	1705	NA	2105
Stack Address	1706	1906	2106
Ignore Fail 2	1707	1907	2107
Sequential Length	1710	1910	2110
Sequential Pattern	1711	1911	2111
Local Memory Instruction	1740	NA	2140

Table 3-6 Surviving Pin Lists

SET CHAIN Surviving Pin List

Chained Surviving Pin	1 5 9 13	16 20 24 28	31 35 39 43	46 50 54
Pin chained to it in Chain 2 mode	2 6 10 14	17 21 25 29	32 36 40 44	47 51 55
Pin chained to it in Chain 4 mode	2 6 10 — 3 7 11 — 4 8 12 —	17 21 25 — 18 22 26 — 19 23 27 —	32 36 40 — 33 37 41 — 34 38 42 —	47 51 55 48 52 56 49 53 57
Rank	1	2	3	4
Chained Surviving pin Sentry VIII	61 65 69 73	76 80 84 88	91 95 99 103	106 110 114
Pin chained to it in Chain 2 Mode, Sentry VIII	62 66 70 74	77 81 85 89	92 96 100 104	107 111 115
Pin chained to it in Chain 4 mode, Sentry VIII	62 66 70 — 63 67 71 — 64 68 73 —	77 81 85 — 78 82 86 — 79 83 88 —	92 96 100 — 93 97 101 — 94 98 102 —	107 111 115 108 112 116 108 112 116
Rank	5	6	7	8

Note

Only Chain Two mode is available when the local memory size requested by the SET PAGE statement is greater than 1024 but less than or equal to 2048. Chaining is not allowed when the local memory size requested is greater than 2048.

Table 3-6 Surviving Pin Lists (Continued)

Tester Surviving and Conditioning Pins for IOMODE

Surviving Pins	1	5	9	13	16	20	24	28	31	35	39	43	46	50	54
Conditioning Pins	2	6	10	14	17	21	25	29	32	36	40	44	47	51	55
SVIII Surviving Pins	61	65	69	73	76	80	84	88	91	95	99	103	106	110	114
SVIII Conditioning Pins	62	66	70	74	77	81	85	89	92	96	100	104	107	111	115

IOM3 Extended Pin List

Sentry V, VII Surviving Pins

1	5	9	13	16	20	24	28	31	35	39	43	46	50	54
3	7	11	15	18	22	26	30	33	37	41	45	48	52	56
4	8	12	—	19	23	27	—	34	38	42	—	49	53	57

Sentry V, VII Conditioning Pins

2	6	10	14	17	21	25	29	32	36	40	44	47	51	55

Sentry VIII Surviving Pins

61	65	69	73	76	80	84	88	91	95	99	193	196	110	114
63	67	71	75	78	82	86	90	93	97	101	105	108	112	116
64	68	72	—	79	83	87	—	94	98	102	—	107	113	117

Sentry VIII Conditioning Pins

62	66	70	72	77	81	85	89	92	96	100	104	107	111	115

Table 3-7 Timing Generator Ranges

Delay/Width Generator

Range	Full Scale/ Auto Range	Resolution
0	10 μs	160 ps
1	100 μs	100 ns
2	1 ms	1 μs
3	10 ms	10 μs

Period Generator

Range	Full Scale	Auto Range Maximum	Resolution
0	40 μs	10 μs	10 μs
1	400 μs	100 μs	100 ns
2	4 ms	1 ms	1 μs
3	40 ms	10 ms	10 μs

Table 3-8 FACTOR/Hardware Relationships

Statement and Options		Registers Written	DMA/INTPR	Time Delay Generated
AT		MCS	D/I(503)	0
BRANCH UNLESS/TO/RESET		PG-MIL	D	
CGEN TGn		TGA0, TGA1, TGA2	D	0
CONN CLK		PPA, RZ	D	2
CONN DPS1/DPS2/DPS3/TCOM		PPA	D	2
CPMU PIN		PA, SR	D/I(612)	2
DISABLE TRIPS		SR	I(646)	0
ENABLE/DISABLE DCT0/DCT1		none	I(631, 632)	0
ENABLE/DISABLE DOUBLE STROBE		SAMB	I(535)	0
ENABLE/DISABLE LATCHES		MR	I(640/641)	0
ENABLE/DISABLE RELAY		PA	D	2
ENABLE/DISABLE SPLIT/RTO/ MUX MODE/IMASK		SAMD	D	
ENABLE DA/DB		F-RANK1		0
ENABLE ILO/IHI/VLO/VHI		none	I(632, 635)	0
ENABLE MA/MB		F-RANK2		0
ENABLE PPM		SAMA	D	0
ENABLE TEST	(no SET START)	S(W)	D	0
	(no SET MAJOR)	L	D	
		MCS,SAMA	D	
		SAMA,SR,SAMB, SAMC,SAMD	I(531)	
	EXTRA/EXT	SAMB,CBC	I	
	LOOP	SAMC	I	
	MATCH	CBC (if time out fail enabled)	I	
	AMATCH	SAMD (if time out fail enabled)	I	
ENABLE TRIPI1/TRIPI2/TRIPI3		SR, DPT1/2/3/,DPS1/2/3	I(601-603)	6
ENABLE TRIPV1/TRIPV2/TRIPV3		SR, DPT1/2/3, DPS1/2/3	I(613-615)	6
FORCE CURRENT/VOLTAGE		PPS, SR	D/I(605)	4
FORCE DELAY		TD (special)	I(642)	9
FORCE E0/E1/. . ./EC1		E0/E1/. . ./EC1, TD	I(620-623)	7
		SAMC (28 volt swing)		
FORCE IF1/IF2/IF3		SR, DPT1/2/3, DPS1/2/3	I(647-651)	6
FORCE PMU		PPS, SR	D/I(607)	4
FORCE RESET		DPS1/2/3, DPT1/2/3, PPS,	I(640)	6

Table 3-8 FACTOR/Hardware Relationships (Continued)

Statement and Options	Registers Written	DMA/INTPR	Time Delay Generated
	RVS, all registers on hardware reset line, MR, DA, DB, MA, MB, SR, SAMA, EIR, TD These registers are restored: bits 1, 2, 7, SAMB, all bits except 4 and 5 MR, bits 0, 12, SR, bit 11 SAMC, SPM mode bit in SAMD, and IND, INC, EIR		
FORCE VF1/VF2, VF3	SR,.DPT1/DPT2/DPT3, DPS1/DPS2/DPS3	I(625-627)	6
FORCE WAIT	None	I(642)	10
label:	IND	I(645)	0
LCGEN TG1/TG2/TG3	F	D	0
LSET IX/STROBE/RZ/INVERT/ DA/DB/MA/MB	F	D	0
LSUBR	F	D	0
MEASURE NODE	SAMA,PA,PSL,DCT,PPS SR on failure	I(616)	
MEASURE PIN (no ENABLE DCT1/DCT0)	DCT,SAMA	D	8
MEASURE VALUE/PIN (ENABLE DCT1/DCT0)	DCT,SAMA,PSL,TD if AUTO ranging	I(616)	
MEASURE PIN ±1,2,6,10	PA,PPS,SAM,DCT	I(616)	
3,4	PA,SAMA,DCT		
5,7,9	PA,PPS,SAMA,DCT		
MEASURE VARIABLE	SAMA	I(616)	0
PGEN LOAD	PG-PCNTR	D	
RD/WR ONE/ZERO/CHECK/ NCHECK	PG-MIL	D	
SET APERIOD	SAMD,TR,SAMC (28 volt swing)	I(507)	0
SET ATG4 DELAY	SAMD,PDV,PD,PWV,PW	I(523)	0
WIDTH	sMD,PWV,PW		
SET ATGn/ BTGn DELAY	SAMD,LRAX,PDV,PD, PWV,PW	I(520-527, 550-557)	
WIDTH	SAMD,LRAX,PDV,PD, PWV,PW		
SET CHAIN TWO/FOUR	SAMB,CH	I(541),D	0
OFF	SAMB	I(541)	
SET CLAMP	PSL (Called SPSL in Analysis)		

Table 3-8 FACTOR/Hardware Relationships (Continued)

Statement and Options	Registers Written	DMA/INTP	Time Delay Generated
SET CRO	LRAX, CRO	D	
SET DA	DA	D	2
SET DB	DB	D	2
SET DCT	PSL,DCT	D/I(652)	8
SET DELAY	TD	I(611)	0
SET F	F	D	0
SET FC	F	D	0
SET FI	SAMA,F	I(530)	0
SET IFAIL	IF,SAMC	I(537)	0
COUNT	IF,LRAX,IF2,SAMC		
SET INVERT	INVERT (W)	D	0
SET IOM3 pin list	SAMD, SAMB, CH	I(501),D	0
OFF	SAMD, SAMB	I(521)	
SET LOGIC	MR	I(640, 641)	0
SET MA	MA	D	0
SET MAJOR loop count	N	D/I(506)	0
last address	L	D/I(504)	
SET MB	MB	D	0
SET MINOR loop-count	M	D/I(506)	0
start μ end	J,K	D/I(505)	
SET PAGE	SAMB,SAMA,S,N,MCS, J,K,L,M,TR,F,DA,DB MA,MB,IND,SAMD	I(501)	0
SPM	SAMD		
SET PERIOD	TR,SAMC (28 volt swing)	I(507)	0
SET PGEN1	PG-PS, PG-SIZE PG-XSIZE	D	
SET PGENA/PGENC/PGENCN/ PGEND/PGENDN	PG-PS	D	
SET PMU SENSE	PSL	I(617)	5
FORCEV	PPS, SR		4
FORCEI	PPS, SR		4
SET PPM	SAMD	I(534)	0
SET Q	LRAX, QL, Q	I(533)	0
SET R	R	D	3
SET RZ	RZ	D	0
SET S1/S0/SA1/SA0	S1/S0/SA1/SA0,TD,SAMC (28 volt swing)	I(630, 654)	7
SET S	S	D	1
SET SI	SAMA,S	I(520)	0
SET START	S	D/I(502)	0
SET STROBE	ST	D	0
SET TG DELAY	PDV,PD,PWV,PW	I(510-517)	0
WIDTH	PWV,PW		
SET TEST±	PPS,PA	I(655)	
SET XOR	LRAX,XOR	D	

Table 3-8 FACTOR/Hardware Relationships (Continued)

Statement and Options	Registers Written	DMA/INTP	Time Delay Generated
WRITE (register)	(register)	I(605)	0
XCON PIN	PPA	D	2
XCON VF1/VF2/VF3	DPT.DPS.SR	I(612)	6
XPMU PIN	PA	D	2

Time Delay	Description
0	no delay
1	0.28 millisecond
2	.0.56 millisecond
3	1.75 millisecond
4	Programmed dc time delay or 0.56 millisecond with no current range change or 4 milliseconds (±1 millisecond) with current range change, whichever is greater.
5	0.56 millisecond with no current range change or 4 milliseconds with current range change.
6	Programmed dc time delay or 5.37 milliseconds, whichever is greater.
7	Approximately 300 microseconds per volt of change or 0.56 millisecond, whichever is greater.
8	56 microseconds
9	Programmed dc time delay
10	The time required for the tester to become not busy.

4 FST-2 Computer

Assembly Language Programs

See DOPSYASM, MASTR ASM, CREATE, and DEBUG commands. The following assembler directives, contained within the assembly language program, allows the operator to describe or select assembly options; define groups of data, character strings or storage areas; specify symbol values; or assign location values.

Assembler Directives

ABS
Indicates the object program is not to be relocated when loaded (i.e. assembly and execution address are the same). Must occur in source before any object code is produced.

(label) BSS expression
Saves a block of storage N words in size.

label	References the first word of the block.
expression	Must be reducible to an absolute value; cannot contain any forward reference.

(label) CALL (symbol)
Generates a BSM instruction and allows the CREATE procedure to link the BSM to the PROC whose label is the same as the symbol of the CALL.

label	Assigned current value of the location counter.

(label)DATA expression (,...,expression n)
Enters constants and data into the program. Each expression in the operand generates a 24-bit binary value.

label	References the first operand expression.

END
Indicates end of the source program has been reached.

label EQU (expression) ,(expression)
Assigns value to symbols. No object code is generated.

label	Assigned the value of the first operand expression.
second expression	Defines opcode and operand format as follows:

Bits	**Meaning**	
0 to 2	Operand Type	
	0	User operand expressions are ORed with opcode value
	1	(address)
	2	(address) ,(index)
	3	(index)
	4	(index), (address)
	5	(indicator/state), (address)
	6	(state) ....,(state)
3	0	Not Augmented
	1	Augmented
4 to 5	Opcode Type	
	1	No Operand Required
	2	Operand Required
6	0	No Indirection allowed
	1	Indirection allowed
8	0	No Memory Reference
	1	Memory Reference

LIST/NOLIST
Controls which portions of the program produce an assembly listing.

OBJ expression
Specifies the maximum number of expressions to be placed in each object record.

number 1 to 14 (default=7)

(label) ORG expression
Sets the value of the current location counter to the value of the expression.

label Assigned value of the location counter *before* counter is assigned its new value.

special expression *↑ Forces location counter to an even location for double precision operands.

PAGE
Forces a top-of-form; i.e., the PAGE record will be the first line listed on the next page.

label PROC (expression)
Assigns the value of the current location counter to the symbol in the label field and allows the CREATE procedures to link the BSMs generated by CALL's to the symbols defined by PROC.

expression If present and not zero, its value (must be less than 64) is an interrupt entry address that CREATE will use to link the interrupt to the PROC.

label PZE 0
Forces a word of zeroes into the output.

REL
Indicates all relocatable memory reference instructions will have bit 23 set to 1 unless ABS is specified. Must appear before any instruction.

(label)TEXT 'character string . . . .'

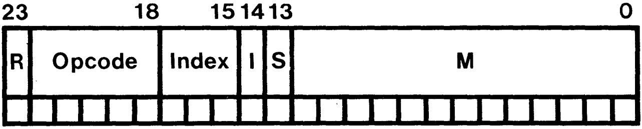
Allows the program to define a literal character string (e.g. informative comments, operating instructions, error messages). Each 4 characters (maximum 64) generates one word.

string — Must begin and end with single quote: Any character in table 4-2 (except single quote) allowed.

FST-2 Instruction Set

Memory Reference Instructions

Format:



R — Relocation field to specify absolute (0) or relocatable (1)

Opcode — Operand code field

Index — Index field

I — Direct (0) or indirect (1) address field

S — Sign field to specify positive (0) or negative (1) indexing.

M — Memory field of instruction

Arithmetic Instructions

		Op	**Equation**
ADD	Addition	20	$(A)+(Me)\rightarrow A$
SUB	Subtraction	22	$(A)-(Me)\rightarrow A$
DADD	Double Addition	30	$(A,E) + (Me,Me+1)\rightarrow A,E$
DSUB	Double Subtraction	32	$(A,E) - (Me,Me+1)\rightarrow A,E$
MUL	Multiply	34	$(Me)*(A)\rightarrow A,E$
DIV	Division	35	$(A,E)/(Me)\rightarrow E$, Remainder$\rightarrow A$
AOM	Add One to Memory	36	$(Me)+1\rightarrow Me$
SOM	Subtract One from Memory	37	$(Me)-1\rightarrow Me$

Data Transfer Instructions

		Op	Equation
STA	Store A	14	(A)→Me
STE	Store E	15	(E)→Me
LDA	Load A	24	(Me)→A
LDE	Load E	25	(Me)→E
DLD	Double Load A,E	31	(Me,Me+1)→A,E
DST	Double Store A,E	33	(A,E)→Me, Me+1

Index Instructions

		Op	Equation
LDX	Load Index	05	Me→Xn
ATX	Add to Index	11	Me+(Xn)→Xn
STX	Store Index	16	(Xn)→Me

Logical Instructions

		Op	Equation
RUM	Replace Under Mask	17	[(Me) AND (E)] EOR [(A) AND ($\overline{E}$)]→A
EOR	Exclusive OR	21	(A) EOR (Me)→A
AND	Logical AND	26	(A) AND (Me)→A
OR	Logical OR	27	(A) OR (Me)→A
NOP	No Operation	10	No Operation

Compare Instruction

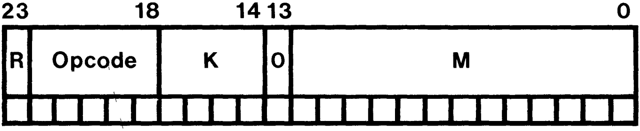
		Op	Equation
CAM	Compare A with Memory	23	(A) is compared with (ME) GT indicator set if (A) > (Me) EQ indicator set if (A) = (Me) LT indicator set if (A) < (Me) BE set if any corresponding bit positions of both A and Me contain a one.

Unconditional Branch/Branch Store Instructions

		Op	Equation
BAH	Branch after Halt	00	Halt and Branch to Me when CPU START is pressed
BRU	Branch Unconditionally	01	Branch Unconditionally to Me
BSM	Branch Store Return at M	12	Branch to Me+1, Store Return at Me; store (>), (=), (<), (B), (Ov) in Me bits 22-18 respectively

Conditional Branch/Branch Instructions

Format:



K = Condition

		Op	Equation
BAT	Branch A Register Test	02	Branch to M on A Register Test
BP	Branch Positive		K=1000
BPZ	Branch Positive or Zero		K=1100
BZ	Branch Zero		K=0100
BNZ	Branch Negative or Zero		K=0110
BN	Branch Negative		K=0010
BNEZ	Branch Not Equal to Zero		K=1010
BO	Branch Odd		K=0001
BIO	Branch on Indicator	03	Branch to M if Tested Indicator(s) Set

Conditional Branch/Branch Store Instructions (Continued)

		Op	Equation
BG	Branch Greater		K=1000
BGE	Branch Greater or Equal		K=1100
BE	Branch Equal		K=0100
BLE	Branch Less Than or Equal		K=0110
BL	Branch Less Than		K=0010
BNE	Branch Not Equal		K=1010
BBC	Branch Bit Compare		K=0001
BOS	Branch on State	04	Branch to M if State K Set

K	State Tested	K	State Tested
0	Switch Flip-Flop 0	10	Interrupt Enable IE
1	Switch Flip-Flop 1	11	Overflow Indicator OV (reset after test)
2	Switch Flip-Flop 2	12	Console Switch CS0
3	Switch Flip-Flop 3	13	Console Switch CS1
4	Switch Flip-Flop 4	14	Console Switch CS2
5	Switch Flip-Flop 5	15	Console Switch CS3
6	Switch Flip-Flop 6	16	Console Switch CS4
7	Switch Flip-Flop 7	17	Console Switch CS5

Augmented Instructions

Format:

23	18	15	14	6	0
07		Index	0	Augment	Shift Count/ or Augment

Arithmetic Instructions

		Opcode	Equation
TCA	Two's Complement	07002000	Two's Complement of (A)→A
DTC	Double Two's Complement	07014000	Two's Complement of (A,E)→ A,E

Data Transfer Instructions

		Opcode	Equation
RSR	Read Switch Register	07006000	(W)→A
EXC	Exchange A,E	07010000	(A)→E, (E)→A
LRA	Load RR from A	07000400	(A)→RR
LAR	Load A from RR	07000600	(RR)→A
CLA	Clear A	07000604	0→A

Index Instructions

		Opcode	Equation
LXA	Load Index from A	07000000	(A)→Xn
LAX	Load A from Index	07000200	(Xn)→A

Shift Instructions

Timing Equation: T=2+ [(Je-9)/5] integer cycles

		Opcode	Equation
DSN	Double Shift Normalize	07016000	Normalize A and E
SR	Shift Right	07020000	Shift (A) Right Arithmetical
LS	Logical Shift	07022000	Shift (A) Right Logical
SA	Shift Around	07024000	Shift (A) Left Around
SL	Shift Left	07026000	Shift (A) Left End Off
DSR	Double Shift Right	07030000	Shift A,E Right Arithmetical
LDS	Logical Double Shift	07032000	Logical Shift A,E Right
DSA	Double Shift Around	07034000	Shift A,E Around Left
DSL	Double Shift Left	07036000	Shift A,E Left

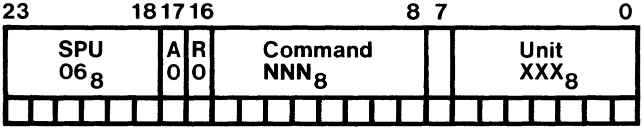
State Control Instructions

		Opcode	Equation
SST	Set State	07004000	Set States Defined by C
RST	Reset State	07012000	Reset States Defined by C

Operand Address Bit	**State F-F Affected**	**Operand Address Bit**	**State F-F Affected**
OP0	SW0	OP5	SW5
OP1	SW1	OP6	SW6
OP2	SW2	OP7	SW7
OP3	SW3	OP8	IEN
OP4	SW4	OP9	OV
		OP14	PD

I/O Instructions

Format:



A=1	Accumulator Transfer.
R=1	Transfer from peripheral unit to Accumulator.
R=0	Transfer from Accumulator to peripheral unit.

		Opcode	**Equation**
SPU	Select Peripheral Unit	060000000	Select Peripheral Unit "U"

Multiple Device Instructions

Instruction	**Opcode**	**Description**	**Devices**
STST	060000XX	Status Test	All
ETST	060100XX	Error Test	Fixed Disk, Card Reader Tape
RDS	066114XX	Read Status	VKT, Card Reader, Disk, Tape
PON	060130XX	Enable Interrupt	All
POFF	060110XX	Disable Interrupt	All
PCOMP	060010XX	Interrupt Complete	All

Specific Device Instructions

VK1, VK2		
RD	0660142X	Read VK1 or VK2
	0602042X	Feed paper tape
VP1, VP2		
WRIT	0642143X	Write to VP1 or VP2
CR		
RD	06401440	Read Card Binary
RD	06403440	Read Card BCD
LP		
WRIT	06421460	Write to line printer
DISK		
RD	06401470	Read from disk
ARD	06403470	Alternate read from disk (Parity Test)
ARDS	06613470	Alternate read status from disk (TASA)
WRIT	06421470	Write disk
MAGNETIC TAPE		
RDT	0650150X	Read from tape
ART	0640150X	Alternate read from tape (Parity Test)
RSKIPF	0600150X	Skip record forward
RSKIPB	0601150X	Skip record backward
FSKIPF	0604150X	Skip file forward (advance past next tape mark)
FSKIPB	0605150X	Skip file backward (backspace to next tape mark or BOT)
WRIT	0642150X	Write tape
SKWR	0646150X	Skip and Write
WRITM	0606150X	Write Tape Mark
REWIND	0600050X	Rewind tape
REWC	0661170X	Read Excess Word Count
TESTER		
RD	066XX120	Read
WRIT	064XX120	Write
SPECIAL	062XX120	Special
NOOP	060XX120	No Operation
COMM LINK		
WDTD	0650013X	Write to Comm Link
RDTD	0670013X	Read from Comm Link

WDTC	0644013X	Write control function
LDTS	0601213X	Latch UART status
RDTS	0664013X	Read UART status
RDSS	0660413X	Read RS232 status
RSTI	0601013X	Reset interface
LOTB	0602013X	Control function load
RDSQ	0650053X	Read sequence register
SPÁR	0602113X	Spare

IEEE-488 bus

SRE	0600214X	Send Remote Enable
RRE	0600314X	Reset Remote Enable
GTS	0600414X	Go to Standby
SIC	0600514X	Send Interface Clear
RPP	0600614X	Request Parallel Poll
TCON	0601014X	Take Control
RDD	0660154X	Read data
WRIT	0642154X	Write data
BCOM	0643154X	Bus command
LTN	06016000X	Local listen

Peripheral Device Characteristics

Peripheral Device	Unit Address	Interrupt Priority 1 is Lowest	Interrupt Address	Memory Priority 1 is Highest
VKT Keybd (VK1/2)	020/21	1	02	—
VKT Printer (VP1/2)	030/31	2	03	—
Card Reader (CR)	040	5	04	5
Line Printer (LP)	060	3	06	—
Disk (fixed)	070	8	07	12
Mag Tape (MTx)	10X	7	10	8
Tester	120	9	12 to 21	1
Comm Link	13X	11	30 to 37	—
488 Bus	14X	6	40 to 43	—

Status bit return (except ETST):

20	BE	Not available
21	LT	Busy
22	EQ	Idle with error
23	GT	Idle no error

Table 4-1 CR Controller Code Conversions

Octal TRASCII	7-Bit ASCII	ALPHA	HOLLERITH	System Character	029 Equiv.
00	040	20	NO PUNCH	SPACE	
01	041	00	11-8-2	!	
02	042	17	8-7	"	
03	043	13	8-3	#	
04	044	53	11-8-3	$	
05	045	34	0-8-4	%	
06	046	60	12	&	
07	047	15	8-5	'	
10	050	75	12-8-5	(	
11	051	55	11-8-5	)	
12	052	54	11-8-4	*	
13	053	76	12-8-6	+	
14	054	33	0-8-3	,	
15	055	40	11	−(Minus)	
16	056	73	12-8-3	.	
17	057	21	0-1	/	
20	060	12	0	0	
21	061	01	1	1	
22	062	02	2	2	
23	063	03	3	3	
24	064	04	4	4	
25	065	05	5	5	
26	066	06	6	6	
27	067	07	7	7	
30	070	10	8	8	
31	071	11	9	9	
32	072	32	0-8-2	:	0-8-2
33	073	56	11-8-6	;	
34	074	72	12-0	<	12-0
35	075	16	8-6	=	
36	076	52	11-0	>	11-0
37	077	37	0-8-7	?	
40	100	14	8-4	@	
41	101	61	12-1	A	
42	102	62	12-2	B	
43	103	63	12-3	C	
44	104	64	12-4	D	
45	105	65	12-5	E	
46	106	66	12-6	F	

Table 4-1 CR Controller Code Conversions (Continued)

Octal TRASCII	7-Bit ASCII	ALPHA	HOLLERITH	System Character	029 Equiv.
47	107	67	12-7	G	
50	110	70	12-8	H	
51	111	71	12-9	I	
52	112	41	11-1	J	
53	113	42	11-2	K	
54	114	43	11-3	L	
55	115	44	11-4	M	
56	116	45	11-5	N	
57	117	46	11-6	O	
60	120	47	11-7	P	
61	121	50	11-8	Q	
62	122	51	11-9	R	
63	123	22	0-2	S	
64	124	23	0-3	T	
65	125	24	0-4	U	
66	126	25	0-5	V	
67	127	26	0-6	W	
70	130	27	0-7	X	
71	131	30	0-8	Y	
72	132	31	0-9	Z	
73	133	74	12-8-4	[	<
74	134	57	11-8-7	/	
75	135	36	0-8-6	]	>
76	136	77	12-8-7	↑	|
77	137	35	0-8-5	←	-

All other hole punch combinations are illegal in the Read Alpha mode and will be flagged by "Validity Error, S11".

Table 4-2 OPCODES (Alpha Sort)

OPCODE	Mnemonic	Code Description	Cycles
	ABS	Absolute Program Locator	
* 20000000	ADD	Add	2
* 26000000	AND	Logical AND	2
* 36000000	AOM	Add One To Memory	4
064034XX	ARD	Alternate Read	1
066134XX	ARDS	Alternate Read Status	1
06422400	ASPAC	Alternate Space	1
06401500	ART	Alternate Read Record Tape	1
* 11000000	ATX	Add To Index	2
07000000	AUG	Augment	
06423400	AWRIT	Alternate Write	1
* 00000000	BAH	Branch After Halt	1
* 02000000	BAT	Branch On A-Register Test	1
* 03040000	BBC	Branch Bit Compare	1
* 03200000	BE	Branch If Equal	1
* 03400000	BG	Branch If Greater	1
* 03600000	BGE	Branch If Greater Or Equal	1
* 03100000	BL	Branch If Less	1
* 03300000	BLE	Branch If Less Or Equal	1
* 02100000	BN	Branch If Negative	1
* 03500000	BNE	Branch Not Equal	1
* 02500000	BNEZ	Branch If Not Equal To Zero	1
* 02300000	BNZ	Branch If Negative Or Zero	1
* 02040000	BO	Branch If Odd	1
* 03000000	BOI	Branch On Indicator	1
* 04000000	BOS	Branch On State	1
* 04440000	BOV	Branch On Overflow	1
* 02400000	BP	Branch If Positive	1
* 02600000	BPZ	Branch If Positive Or Zero	1
* 01000000	BRU	Branch Unconditional	1
* 12000000	BSM	Branch Store Return At M	2
	BSS	Block Storage Size	
* 02200000	BZ	Branch If Zero	1
12000000	CALL	Subroutine Call	
* 23000000	CAM	Compare A With Memory	2
07000604	CLA	Clear Accumulator	1
* 30000000	DADD	Double Add	3
*	DATA	Data Definition	
* 35000000	DIV	Divide	26
* 31000000	DLD	Double Load	3
07034000	DSA	Double Shift Around	

Table 4-2 OPCODES (Alpha Sort) (Continued)

OPCODE	Mnemonic	Code Description	Cycles
07036000	DSL	Double Shift Left	
07016000	DSN	Double Shift Normalized	
07030000	DSR	Double Shift Right	
* 33000000	DST	Double Store	3
* 32000000	DSUB	Double Subtract	3
07014000	DTC	Double Two's Complement	2
	END	Program Terminator	
* 21000000	EOR	Exclusive OR	2
	EQU	Equivalence	
060100XX	ETST	Error Test	1
07010000	EXC	Exchange A And E	1
06051500	FSKIPB	Skip File Backward (Go Back To Tape Mark)	1
06041500	FSKIPF	Skip File Forward (Advance To Tape Mark)	1
07012400	IDA	Interrupt Disable	1
07004400	IEN	Interrupt Enable	1
07000600	LAR	Load A From Relocation Register	1
07000200	LAX	Load A From Index	1
* 24000000	LDA	Load A-Register	2
* 25000000	LDE	Load E-Register	2
07032000	LDS	Logical Double Shift	
* 05000000	LDX	Load Index	1
	LIST	Produce Assembly Listing	
07000400	LRA	Load Relocation Register From A	1
07022000	LS	Logical Shift A	
07000000	LXA	Load Index From A	1
* 34000000	MUL	Multiply	25
	NOLIST	No Assembly Listing	
* 10000000	NOP	No Operation	1
	OBJ	Produce Object Program	
* 27000000	OR	OR (Inclusive)	2
	ORG	Origination Control	
	PAGE	Pagination Control	
060010XX	PCOMP	Priority Complete	1
060110XX	POFF	Priority Off (Interrupt Disable)	1
060130XX	PON	Priority On (Interrupt Enable)	1
00000000	PROC	Subroutine Entry Point	
00000000	PZE	Positive Zero (Entry Point)	
064014XX	RD	Read	1
066114XX	RDS	Read Status	1
06501500	RDT	Read (Magnetic) Tape	1

Table 4-2 OPCODES (Alpha Sort) (Continued)

OPCODE	Mnemonic	Code Description	Cycles
06601400	RDTT	Read Teletype	1
06611700	REWC	Read Excess Word Count	1
06000500	REWIND	Rewind Tape	1
06011500	RSKIPB	Skip Record Backward	1
06001500	RSKIPF	Skip Record Forward	1
07006000	RSR	Read Switch Register	1
07012000	RST	Reset State	1
* 17000000	RUM	Replace Under Mask	2
07024000	SA	Shift A Around Left	
06461500	SKWR	Skip And Write	1
07026000	SL	Shift A Left	
* 37000000	SOM	Subtract One From Memory	4
06420400	SPAC	Space	1
06000000	SPU	Select Peripheral Unit	1
07020000	SR	Shift A Right	
07004000	SST	Set State	1
* 14000000	STA	Store A-Register	2
* 15000000	STE	Store E-Register	2
07000611	STM1	Set FST-1 Mode	1
07000612	STM2	Set FST-2 Mode	1
060000XX	STST	Status Test	1
* 16000000	STX	Store Index	2
* 22000000	SUB	Subtract	2
07002000	TCA	Two's Complement A	1
06000400	TOF	Top-Of-Form	1
064214XX	WRIT	Write	1
06061500	WRITM	Write Tape Mark	1

* B23=0 for Absolute Memory Reference of Non-REL Program
=1 for Relocation Memory Reference with REL Program

Table 4-3 OPCODES (Octal Sort)

OPCODE	Mnemonic	Code Description	Cycles
	ABS	Absolute Program Locator	
00000000	BSS	Block Storage Size	
* 00000000	DATA	Data Definition	
00000000	END	Program Terminator	
	EQU	Equivalence	
	LIST	Produce Assembly Listing	
	NOLIST	No Assembly Listing	
	OBJ	Specify Object Program Size	
	ORG	Origination Control	
	PAGE	Pagination Control	
* 00000000	BAH	Branch After Halt	1
00000000	PROC	Subroutine Entry Point	
00000000	PZE	Positive Zero (Entry Point)	
* 01000000	BRU	Branch Unconditional	1
* 02000000	BAT	Branch On A-Register Test	1
* 02040000	BO	Branch If Odd	1
* 02100000	BN	Branch If Negative	1
* 02200000	BZ	Branch If Zero	1
* 02300000	BNZ	Branch If Negative Or Zero	1
* 02400000	BP	Branch If Positive	1
* 02500000	BNEZ	Branch If Not Equal To Zero	1
* 02600000	BPZ	Branch If Positive Or Zero	1
* 03000000	BOI	Branch On Indicator	1
* 03040000	BBC	Branch Bit Compare	1
* 03100000	BL	Branch If Less	1
* 03200000	BE	Branch If Equal	1
* 03300000	BLE	Branch If Less Or Equal	1
* 03400000	BG	Branch If Greater	1
* 03500000	BNE	Branch Not Equal	1
* 03600000	BGE	Branch If Greater Or Equal	1
* 04000000	BOS	Branch On State	1
* 04440000	BOV	Branch On Overflow	1
* 05000000	LDX	Load Index	1
06000000	SPU	Select Peripheral Unit	1
060000XX	STST	Status Test	1
06000400	TOF	Top-Of-Form	1
06000500	REWIND	Rewind Tape	1
060010XX	PCOMP	Priority Complete	1
06001500	RSKIPF	Skip Record Forward	1
060100XX	ETST	Error Test	1

Table 4-3 OPCODES (Octal Sort) (Continued)

OPCODE	Mnemonic	Code Description	Cycles
060110XX	POFF	Priority Off (Interrupt Disable)	1
06011500	RSKIPB	Skip Record Backward	1
060130XX	PON	Priority On (Interrupt Enable)	1
06020400	FEED	Character (Paper Tape) Feed	1
06041500	FSKIPF	Skip File Forward (Advanced To Tape Mark)	1
06051500	FSKIPB	Skip File Backward (Go Back To Tape Mark)	1
06061500	WRITM	Write Tape Mark	1
064014XX	RD	Read	1
06401500	ART	Alternate Read Record Tape	1
064034XX	ARD	Alternate Read	1
06420400	SPAC	Space	1
064214XX	WRIT	Write	1
06422400	ASPAC	Alternate Space	1
06423400	AWRIT	Alternate Write	1
06461500	SKWR	Skip And Write	1
06501500	RDT	Read (Magnetic) Tape	1
06601400	RDTT	Read Teletype	1
066114XX	RDS	Read Status	1
06611700	REWC	Read Excess Word Count	1
06613400	ARDS	Alternate Read Status	1
07000000	AUG	Augment	
07000000	LXA	Load Index From A	1
07000200	LAX	Load A From Index	1
07000400	LRA	Load Relocation Register From A	1
07000600	LAR	Load A From Relocation Register	1
07000604	CLA	Clear Accumulator	1
07000611	STM1	Set FST-1 Mode	1
07000612	STM2	Set FST-2 Mode	1
07002000	TCA	Two's Complement A	1
07004000	SST	Set State	1
07004400	IEN	Interrupt Enable	1
07006000	RSR	Read Switch Register	1
07010000	EXC	Exchange A And E	1
07012000	RST	Reset State	1
07012400	IDA	Interrupt Disable	1

Table 4-3 OPCODES (Octal Sort) (Continued)

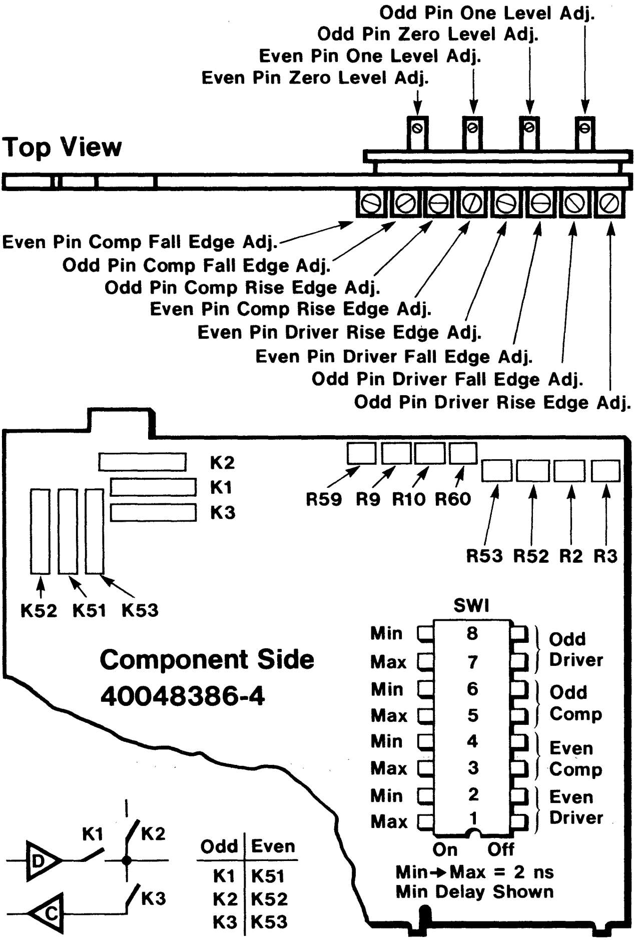
OPCODE	Mnemonic	Code Description	Cycles
07014000	DTC	Double Two's Complement	2
07016000	DSN	Double Shift Normalized	
07020000	SR	Shift A Right	
07022000	LS	Logical Shift A	
07024000	SA	Shift A Around Left	
07026000	SL	Shift A Left	
07030000	DSR	Double Shift Right	
07032000	LDS	Logical Double Shift	
07034000	DSA	Double Shift Around	
07036000	DSL	Double Shift Left	
* 10000000	NOP	No Operation	1
* 11000000	ATX	Add.To Index	2
* 12000000	BSM	Branch Store Return At M	2
12000000	CALL	Subroutine Call	
* 14000000	STA	Store A-Register	2
* 15000000	STE	Store E-Register	2
* 16000000	STX	Store Index	2
* 17000000	RUM	Replace Under Mask	2
* 20000000	ADD	Add	2
* 21000000	EOR	Exclusive OR	2
* 22000000	SUB	Subtract	2
* 23000000	CAM	Compare A With Memory	2
* 24000000	LDA	Load A-Register	2
* 25000000	LDE	Load E-Register	2
* 26000000	AND	Logical AND	2
* 270000000	OR	OR (Inclusive)	2
* 30000000	DADD	Double Add	3
* 31000000	DLD	Double Load	3
* 32000000	DSUB	Double Subtract	3
* 33000000	DST	Double Strobe	3
* 34000000	MUL	Multiply	25
* 35000000	DIV	Divide	26
* 36000000	AOM	Add One To Memory	4
* 37000000	SOM	Subtract One From Memory	4

* Bit 23=0 for Absolute Reference of non-REL Program
=1 for Relocation Memory Reference with REL Directive

A

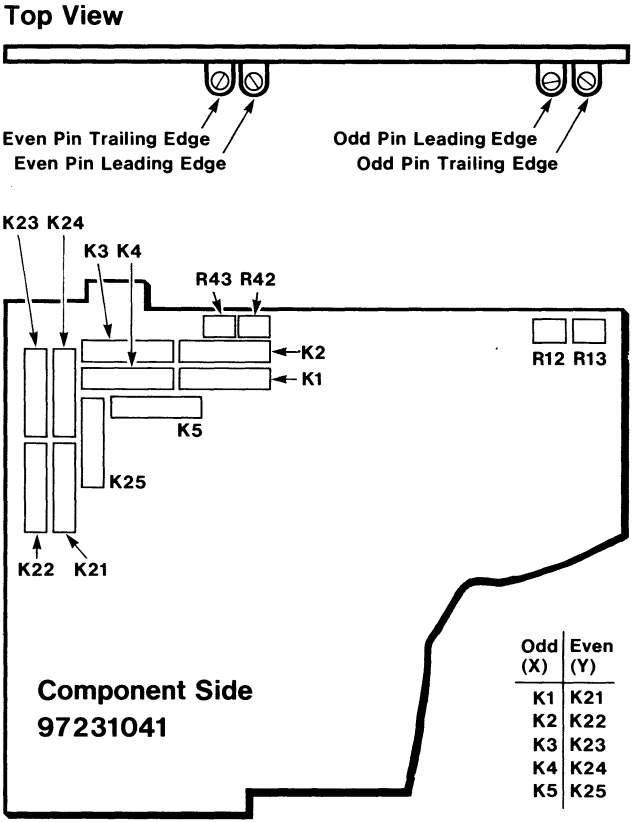
Appendix A

Hardware Block Diagrams



Odd	Even
K1	K51
K2	K52
K3	K53

Figure A-1 High Speed Pin Electronics Card



Odd (X)	Even (Y)
K1	K21
K2	K22
K3	K23
K4	K24
K5	K25

Figure A-2 10 MHz, HV Pin Electronics Card

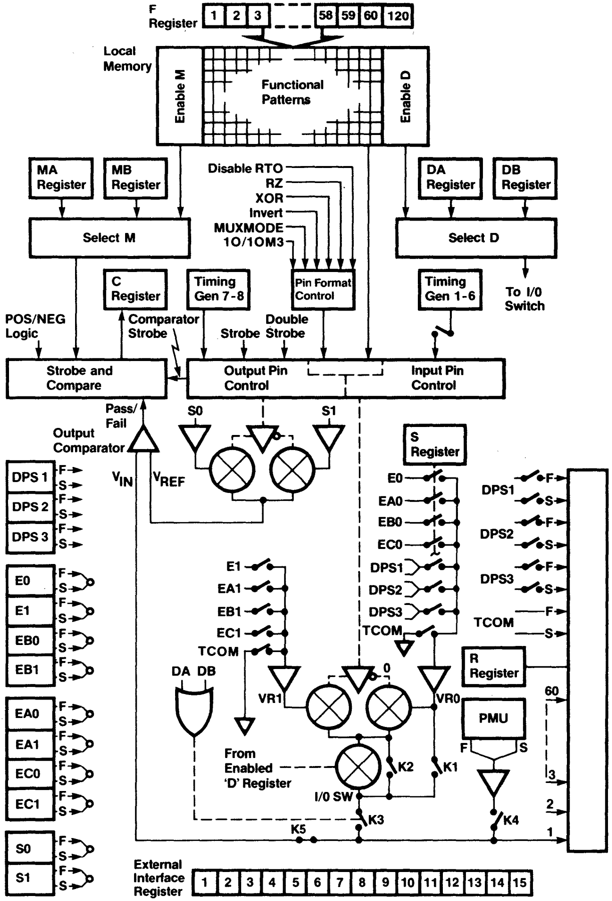


Figure A-3 Sentry Programmers Simplified Block Diagram (General Purpose (GP) Pin Electronics Card)

FAIRCHILD

A Schlumberger Company

Fairchild Test Systems Group
1725 Technology Drive
San Jose, California 95110
(408) 998-0123 TWX: 910 338 0558