AA 5001 Instrument Interfacing Guide

4788-01

This interfacing guide is designed to help you get started using the AA 5001 Distortion Analyzer with a GPIB controller as quickly and easily as possible. This guide tells you how to set AA 5001 switches for GPIB operation and explains how to communicate with the AA 5001 with a variety of controllers. Sample measurement programs for these controllers are also included.

This guide does not take the place of the operators manual or other documentation supplied with the AA 5001 and your system controller. More complete information in this other documentation will help you get the full benefit of the AA 5001's programmable capabilities.

Setting Up the AA 5001 for GPIB Operation

Connect the TM 5000 power module to your controller with a GPIB cable. The program examples in this guide assume that the AA 5001 and controller are the only instruments on the bus.

Setting the Address and Terminator Switches. The switches that select the GPIB address and terminator are accessible through a cutout in the rear panel of the AA 5001. Fig. 1 identifies the switches and illustrates their meanings. Other switch or strap-selectable options in the AA 5001 are explained in the Operators Manual.

For additional copies, order:
070-4788-00
Product Group 76
First Printing NOV 1983

Tektronix®
COMMITTED TO EXCELLENCE

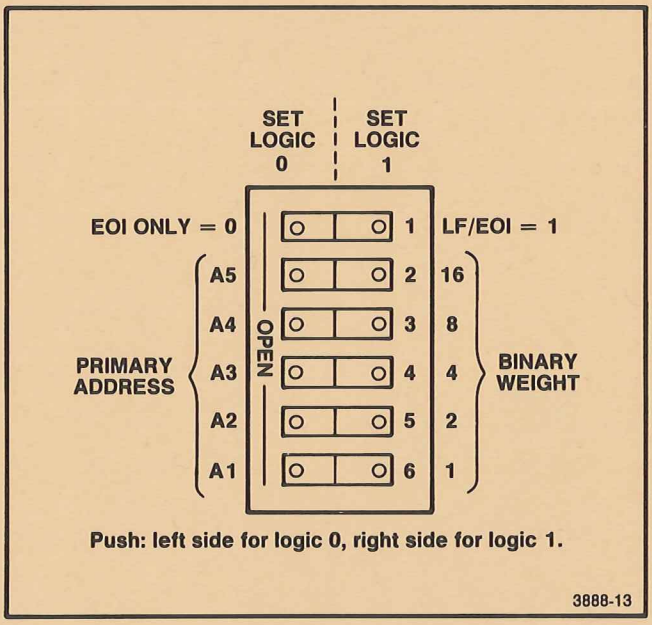

Fig 1. *The address and message terminator switches are located through the cut-out in the rear panel of the AA 5001.*

Valid primary addresses include the range of 0 to 30. (31 effectively disables the AA 5001 from communicating on the GPIB.) If your controller reserves an address for itself, do not set the AA 5001 to that address. This is true of Tektronix 4050-Series controllers, which reserve address 0 for themselves. The Tektronix 4041 defaults to address 30 on power-on, but may be programmed to use any primary address. The AA 5001 ignores secondary addresses.

EOI-only is recommended as the message terminator for use with Tektronix controllers. EOI-or-LF is recommended for use with Hewlett-Packard controllers. (In the latter position, the AA 5001 still recognizes EOI as a terminator and transmits EOI concurrently with the LF character to terminate a message.)

The AA 5001 is supplied from the factory set to an address of 28 and to EOI-only for the message terminator.

Programming The AA 5001

AA 5001 Power-On

The AA 5001 performs a self-test and goes to its default settings on power-on.

Self-Test. If an error occurs, the AA 5001 front panel display is set to the code of the first error detected. The AA 5001 will not perform any other functions if an error has occurred. See the operators manual for the meaning of any error displays.

Power-On Settings. Following a successful self-test, the AA 5001 goes to local state with the front panel settings and the default settings shown in Table 1 (and defined in Table 2).

Table 1
AA 5001 POWER ON SETTINGS

Header	Argument
Count	2.0
DUs	ON
OPc	OFF
Points	3
RQs	ON
TO1	2.0
OVer	OFF

Power-On SRQ. The AA 5001 asserts SRQ to report power-on status after completing the self-test. This can be handled with a serial poll, although the AA 5001 communicates normally on the GPIB and executes the commands it receives whether or not the SRQ is serviced. Some controllers, such as the 4051 and 4052 when used without the 405XR14 GPIB rompack, require that the program contain an SRQ handler and begin by enabling the handler; otherwise the power-on SRQ will cause the program to halt with the error 'NO SRQ ON UNIT.'

AA 5001 Messages

Commands are provided to control AA 5001 settings, cause AA 5001 actions, or request status or measurement data. These commands are listed in Table 2. AA 5001 commands begin with a header—a word or abbreviation that describes the function implemented. The command may include one or more arguments, which are delimited from the header by a space; multiple arguments are delimited by a comma. AA 5001 commands can be combined in a message by separating the commands with the message unit delimiter (semicolon). Either upper or lower-case ASCII characters are accepted.

Table 2
AA 5001 COMMANDS AND DESCRIPTIONS
[ ] = Optional

Header	Argument	Description
Counts	<num>	Sets the settling algorithm window in units of display counts.
Counts?		Returns the COUNTS setting.
DUs?	[ON] OFf	The DUS command tells the SEND command to delay sending a measurement until settling has occurred. Refer to the description for the SEND command.
DUs?		Returns DUS ON or DUS OFF.
ERRMsg?		Has the same action as the ERROR? query except that a brief description string is included in the query response.
ERRor?		Used to obtain information about the status of the instrument. If RQS is ON, the ERROR? query returns an event code <number> describing why the RQS bit was set in the last Status Byte reported by the instrument. The event code is then reset to 0. If RQS is OFF, the ERROR? query returns an event code <number> describing the highest priority condition currently pending in the instrument. This event code is then cleared and another ERROR? query will return the event code for the next highest priority condition pending.
EVent?		Has the same action as the ERROR? query.

Table 2 (cont)

Header	Argument	Description
[FIlters]	BPass EXternal FLat HPass Lpass OFf Wtg BPass? FLat?	Each individual command enables the specified filter. FLAT and OFF disable all the filters. NOTE: "A" WEIGHTING is used on the standard instrument only. "CCIR" WEIGHTING is used on option 2 only. For the setting command, multiple arguments separated by commas are allowed. The arguments are processed from left to right, that is the last argument prevails. The FILTERS heading may be omitted for all arguments except OFF unless multiple arguments are used. If the FILTERS heading is omitted, the arguments ON or OFF may be optionally used. If not used, ON is assumed. BP, LP, and WTG are all mutually exclusive.
FIlters?		Returns a list of the filters that are enabled.
FPset		Sets the AA 5001 to the front panel settings even though it is under remote control. This is useful for allowing manually set input level and distortion ranges, as these are otherwise autoranged when in the remote state. Any other setting command made subsequently will defeat FPset.
[FUnction]	DBm IMDDb IMDPct THDDb THDPct	DBM selects level measurement in decibels relative to 0.775 Volts. IMDDB selects intermodulation distortion

Table 2 (cont)

Header	Argument	Description
	Volts	measurements in decibels. IMDPCT selects intermodulation distortion measurements in percent. THDDB selects total harmonic distortion measurements in decibels. THDPCT selects total harmonic distortion measurements in percent. VOLTS selects level measurement in rms volts. NOTE: DB RATIO is not programmable. References other than 0.775 volts (DBM), if needed, should be calculated by the controller.
FUnction?		Returns the type of measurement selected. The FUnc header is not returned.
HElp?		Returns a list of all valid commands headers.
IDentify?		Returns "ID TEK/AA5001, V81.1,Fx.y;" (standard instruments only) or "ID TEK/AA5001,V81.1,Fx.y, "OPTION 2";"(option 2 only). Fx.y identifies the firmware version number.
INit		Initializes the instrument settings to the following: VOLTS RMS FLAT DUS ON POINTS 3 TOLERANCE 2.0 COUNTS 2.0 OPC OFF OVER OFF RQS ON
OPc	[ON] OFf	Controls the asserting of SRQ when a measurement is completed. This command allows a controller to start a measurement, and then process some other task while waiting for an SRQ to inform it that measurement data is ready. When OPC is ON and a measurement completes, SRQ is asserted and remains asserted until the status is read via a serial poll or until cleared by RQS OFF or a Device Clear. Operation Complete is indicated by a Status Byte of 66 or 82 and an ERROR? query response of ERR 402. For more Status Byte and error information, see "Table 3 ERROR QUERY AND STATUS INFORMATION".
OPc?		Returns OPC ON or OPC OFF.
OVer	[ON] OFf	Controls the asserting of SRQ for display overange, insufficient level, excessive input level, and unsettled conditions. These conditions are checked only when a measurement is attempted (see SEND command).
OVer?		Returns OVER ON or OVER OFF.
Points	<num>	Sets the number of sample points, 2 through 6, that must be within the settling algorithm's tolerance window for settling to occur.The numeric argument in the setting is rounded to the nearest integer.

Table 2 (cont)

Header	Argument	Description
Points?		Returns the POINTS setting.
[REsponse]	AVErage (std instr only) AVG (std instr only) RMs Qpk (opt 2 only)	Sets the AA 5001 for average (quasi-peak for option 2) or rms response.
REsponse?		Returns the RESPONSE setting.
RQs	[ON] OFF	Global control for assertion of SRQ by the AA5001. When RQS is OFF the AA5001 will not assert SRQ under any circumstance. When RQS is ON the AA5001 is allowed to assert SRQ under appropriate circumstances; i.e., errors, operation complete, etc. The ERROR? query can be used while RQS is OFF to see if any SRQ type conditions have occurred. SRQ will be asserted for any previously unreported SRQ event when RQS is turned ON after being OFF.
RQs?		Returns RQS ON or RQS OFF.

Table 2 (cont)

Header	Argument	Description
SENd		Returns a measurement. Overrange is 1E+99. New measurements are available as the display updates at approximately three (3) reading/sec. Any display reading may be returned only once. If the DUS is OFF the most recent display update is returned. If DUS is ON, the measurement must be settled before it is returned. If settling does not occur within six (6) seconds, an average of the last two (2) seconds (6 display updates) is returned, and if the OVER is ON an unsettled SRQ is generated.
SETtings?		Returns the current settings of the instrument. The query response may then be used at a later time to reset the instrument back to those settings.
TEst?		Causes execution of the ROM test and returns TEST 0 if the test passes, or TEST 394 if the test fails.
TOlerance	<num>	Sets the tolerance window in percent of the reading for the settling algorithm.
TOlerance?		Returns the TOLERANCE setting.

Sending Messages to the AA 5001

Most GPIB controllers provide a high-level statement that allows you to transfer device-dependent messages to the AA 5001. In the 4050-Series and the 4041, it's the PRINT statement.

4050-Series:

```
170 PRINT @28:"FUNC VOLTS;FILT BP"
```

4041:

```
170       Print #28:"FUNC VOLTS;FILT BP"
```

A useful variation assigns the AA 5001 address to a variable and inserts that variable in the PRINT statement in place of the number for the address. This works with either the 4050-Series or 4041 and allows you to change the program to work with the AA 5001 set to other addresses by changing only the statement that assigns the variable.

4050:

```
200 D=28
210 PRINT @D:"FUNC VOLTS;FILT BP"
```

4041:

```
200       Aa=28
210       Print #aa:"FUNC VOLTS;FILT BP"
```

Notice that the AA 5001 message (what's inside the quote marks) is the same in all of the above examples. The rest of each example varies to match the PRINT statement syntax designed into each controller as illustrated in Fig. 2. This suggests that once you understand your controller's output and input statements, it's just a matter of plugging in the AA 5001 commands you need.

4050-Series BASIC	PRINT @5:"RQS ON"
4041 BASIC	PRINT #5:"RQS ON"
HP-85 BASIC	OUTPUT 705 ; "RQS ON"
FLUKE 1720A BASIC	PRINT @5%,"RQS ON"
HP 9826 BASIC	OUTPUT 705;"RQS ON"

Fig. 2. *A message to a GPIB device is contained within the controller's GPIB output statement. The statement is composed of three parts: the keyword, the address or logical unit number, and the device-dependent message. All the statements shown send the same standard Tektronix Codes & Formats message (RQS ON) that enables SRQ interrupts. All send the message to an instrument with primary address 5. The difference lies in the syntax of the statement required for a particular controller.*

Getting AA 5001 Current Settings

AA 5001 queries or output commands (such as FUnc?, FIlt?, or SEND) prepare the instrument for output, but do not start such output. The AA 5001 waits until it sees its talk address to begin sending the requested data. This is accomplished by the INPUT statement.

4050-Series:

```
280 PRINT @28:"FUNC?"
290 INPUT @28:F$
```

4041:

```
290       Input #28 prompt "FUNC?":fnction$
```

All instrument settings can be obtained in one message. Just dimension a string large enough (300 characters is plenty) and input the settings string.

4050-Series:

```
330 DIM S$(300)
340 PRINT @28:"SET?"
350 INPUT @28:S$
```

4041:

```
330       Dim setting$ to 300
340       Input #28 prompt "SET?":setting$
```

You can restore the settings you input from the AA 5001 by sending back the settings string.

4050-Series:

```
380 PRINT @28:S$
```

4041:

```
380      Print #28:setting$
```

Getting AA 5001 Measurements

Getting measurements from the AA 5001 is even easier than getting settings data. Sending the AA 5001 talk address, which INPUT does, is enough to cause the AA 5001 to output a reading. (The AA 5001 responds with a reading if it has not been told by a query command to respond with some other output.) The AA 5001 sends the reading as ASCII numeric characters, which may be input into a character string or numeric variable. The variable and its type are specified after the colon in the INPUT statement.

4050-Series:

```
430 INPUT @28:R
```

4041:

```
430      Input #28:reading
```

4050-Series with 405XR14 Rompack:

```
465 REM SERIAL POLL OF ADDRESS 28 ONLY
470 POLL A,S;28
475 PRINT @28:"ERR?"
480 INPUT @28:E
490 PRINT "STATUS=";S,"ERROR=";E
500 RETURN
```

4041:

```
470 Dopoll:      poll stabyt,addr;28
480      Input #addr prompt "ERR?":errnum
490      Print "STATUS=";stabyt,"ADDRESS=";addr,"ERROR=";errnum
500      Resume
```

Using AA 5001 Interrupts

Programmable interrupts are provided in the AA 5001 to inform the controller of asynchronous events, such as operation complete, command errors, overranging, or out-of-limits reading in the compare mode. If the AA 5001 is set to report an event, it asserts SRQ when it detects that event and sets its status byte and error code appropriately. The status byte returned in response to a serial poll and the error code returned in response to an error query (ERR?) correspond to the events shown in Table 3. The error query obtains more detail in the case of abnormal events and some normal events. For instance, in the case of a command error, was it a problem with a header, argument, or delimiter? You can find out from the error code.

Here are typical SRQ handlers that alert you to a reporting instrument's address, status, and error code with a message on your console. The error code is helpful during debugging because it identifies the specific command or execution problem should one occur. To use an SRQ handler, you must link it and enable it as shown in the statements at lines 120 and 130. The sample measurement program does not use the error query because the information that is needed (operation complete) is available from the status byte. It prints the status byte as a failsafe measure only if it is other than the one expected.

Table 3
ERROR QUERY AND STATUS INFORMATION

Abnormal Conditions

Event	Bus response to ERR?	Response to serial poll[a]
Command Errors		
Command header error	101	97 or 113
Header delimiter error	102	97 or 113
Command argument error	103	97 or 113
Argument delimiter error	104	97 or 113
Missing argument	106	97 or 113
Invalid message unit delimiter	107	97 or 113
Execution Errors		
Command not executable in local mode	201	98 or 114
Returned to local, new pending settings lost	202	98 or 114
I/O buffers full, output dumped	203	98 or 114
Argument out of range	205	98 or 114
Group execute trigger ignored	206	98 or 114

Table 3 (cont)
Abnormal Conditions

Event	Bus response to ERR?	Response to serial poll[a]
Internal Errors		
Interrupt fault	301	99 or 115
System error	302	99 or 115
Math pack error	303	99 or 115

Normal Conditions

System Events	0	0 or 16
No errors or events		128 or 144
with data not ready		132 or 148
with data ready		
Power on	401	65 or 81
Operation complete	402	66 or 82
Internal Warning		
Display overrange	601	68 or 84
Device Dependent Events		
Insufficient input level	701	193 or 209
Excessive input level	703	195 or 211
Unsettled	704	196 or 212

[a]If the message processor is busy, the instrument returns the higher decimal number.

AA 5001 Response to Interface Messages

The following program sequences show various interface messages transmitted to the AA 5001.

4052AR14:

```
500 REM INTERFACE MESSAGES
510 REM
520 REM
530 REM  Send Interface Messages from 4050A with R14A rompack
540 REM
550 REM      AA 5001 primary address (factory set to 28) is variable A.
560 REM
570 LET A=28
580 REM                          Send LISTEN ADDRESS
590 CALL "LISTEN";A
600 REM                          UNLISTEN
610 CALL "UNL"
620 REM                          Send TALK ADDRESS
630 CALL "TALK";A
640 REM                          UNTALK
650 CALL "UNT"
660 REM                          Send DEVICE CLEAR
670 CALL "DCL"
680 REM           Send LISTEN ADDRESS, SELECTED DEVICE CLEAR, UNLISTEN
690 CALL "SDC";A
700 REM
710 REM         -- REMOTE WITH LOCKOUT STATE (RWLS) from LOCS or REMS --
720 REM            Send Listen Address, Local Lockout, Unlisten
730 CALL "LISTEN";A
740 CALL "LLO"
750 CALL "UNL"
760 REM
770 REM           Send LISTEN ADDRESS, GO-TO-LOCAL, UNLISTEN
780 CALL "GTL";A
790 REM           Send LISTEN ADDRESS, GROUP EXECUTE TRIGGER, UNLISTEN
800 CALL "GET";A
```

4041:

```
100    !      4041 Controller  GPIB Interface Commands TO AA 5001
105    !                   rev 7/27/83
110 Intrfc:    !
120    !
130      Pri_addr=28 !       primary bus address for AA 5001
140    !
150    !
160 Listen:      wbyte atn(pri_addr+32) !     Send Listen Address (MLA)
170    !
180 Unlisten:      wbyte atn(unl) !           Send Unlisten (UNL)
190    !
200 Talk:      wbyte atn(pri_addr+64) !       Send Talk Address (MTA)
210    !
220 Untalk:      wbyte atn(unt) !             Send Untalk (UNT)
230    !
240 Devclear:      wbyte dcl !                Send Device Clear
250    !
260 Selctclr:      wbyte sdc(pri_addr),atn(unl) ! Send MLA, Selected Device
270    !                                        Clear, UNL
280 Lockout:     wbyte atn(pri_addr+32),llo,atn(unl) ! Send MLA, LLO, UNL
290    !
300 Gtlocal:     wbyte gtl(pri_addr),atn(unl) ! Send MLA, Go To Local, UNL
310    !
320 Trigger:     wbyte get(pri_addr),atn(unl) ! Send MLA, Group Execute
330    !                                        Trigger, UNL
340 Loclstat:      wbyte ren(0),ren(1) !      Pulse unassert REN line
350    !
360      End
```

The AA 5001 responds to DCL (and SDC if listen addressed) by clearing its Input and Output Buffers and any unexecuted setting commands in its Pending Settings Buffer, along with any errors or events waiting to be reported (except power-on).

GET is recognized by the AA 5001. Upon the receipt of the GET message the AA 5001 issues an error.

LLO locks out the operator from restoring local (front-panel) control when the instrument is under remote control.

GTL restores local control if the instrument receives the message while listen addressed.

See the AA 5001 Operators Manual for a full discussion of how the instrument responds to interface messages.

Sample Measurement Program

The following program makes a series of AA 5001 measurements to illustrate command i/o and various measurement triggering modes.

Figs. 3 and 4 are typical program listings.

```
AA 5001 Measurements
Level High Pass:      1.563 Volts
Level Low Pass:       6.2 dBm
THD Band Pass:        0.0016 %
THD Flat Response:    -93.1 dB
```

4788-02

Fig. 3. *Screen output from 4050-Series sample measurement program.*

4052AR14:

```
100    ! ************************************************************
110    ! *************** AA 5001 MEASUREMENT PROGRAM ****************
120    ! ************************************************************
130    !
140    ! For 4050A Series: October 5, 1983
150    !
160    ! Copyright (c) 1983 Tektronix, Inc.  All rights reserved.  This
170    ! software is provided on an "as is" basis without warranty of
180    ! any kind.  It is not supported.
190    !
200    ! This program may be reproduced without prior permission, in
210    ! whole or in part, by the original purchaser.  Copies must
220    ! include the above copyright and warranty notice.
230    !
240    ! PURPOSE:
250    ! Makes four different AA 5001 measurements and prints them
260    ! on the 4050A Series screen.
270    !
280    ! REQUIRED EQUIPMENT:
290    ! AA 5001 Programmable Distortion Analyzer.
300    ! 4050A Series Controller
310    !
320    ! PROGRAM SEGMENT VARIABLES:
330    ! aaprim          AA 5001 primary address. Factory set to 28.
340    ! _toleran        tolerance for Delay Until Settled algorithm.
350    ! counts          number of counts for DUS algorithm in AA 5001.
360    ! _points         number of readings to be within tolerance and
370    !                 counts.
380    !
390    ! OPERATING INSTRUCTIONS:
400    ! Connect output of DUT to input of AA 5001. Address of AA 5001
410    ! must be set to 28.
420    ! If address is different from this  factory set address, then
430    ! variable aaprim ( AA 5001 primary address ) must be
440    ! changed accordingly.
450    !
460    ! ERRORS:
470    ! AA 5001 address must be set to 28.
480    ! If not program assignment of variable aaprim must be
490    ! changed accordingly.
500    !
510    ! INSTRUMENT CONTROL:
520    ! Polls instruments on assigned addresses (AA 5001 ).
530    !
540    ! ************************************************************
550    ! Begin main program segment
560 INIT
570 PAGE
580 Aaprim=28
590 _toleran=0.1
600 Counts=1
610 _points=6
620 ON SRQ THEN 1110
630    !
640    ! Initialize AA 5001.
650 WBYTE @Aaprim+32:73,78,73,-84
660 WBYTE @95,63:
670    ! Lock out the AA 5001 front panel.
680 WBYTE @17:
690    ! Set up AA 5001 to delay sending a reading until settled.
700    ! Set tolerance, number of counts, and number of points.
710 PRINT @Aaprim:"DUS ON;TOL "; _toleran;";COUNTS ";Counts
720 PRINT @Aaprim:"POINTS "; _points
```

```
730 PRINT "AA 5001 Measurements"
740   !Set up AA 5001 for VOLTS Function, filter high pass, RMS.
750 PRINT @Aaprim:"FUNC VOLTS;FILT HP;RESP RMS"
760   ! Input a reading from AA 5001.
770 PRINT @Aaprim:"SEND"
780 INPUT @Aaprim:Voltshp
790 PRINT "Level High Pass:      ";Voltshp;" Volts"
800   !Set up AA 5001 for DBM Function, filter low pass, RMS.
810 PRINT @Aaprim:"FUNC DBM;FILT LP;RESP RMS"
820   ! Input a reading from AA 5001.
830 PRINT @Aaprim:"SEND"
840 INPUT @Aaprim:Dbmlp
850 PRINT "Level Low Pass:       ";Dbmlp;" dBm"
860   !Set up AA 5001 for VOLTS Function, filter bandpass, RMS.
870 PRINT @Aaprim:"FUNC THDPCT;FILT BP;RESP RMS"
880   ! Input a reading from AA 5001.
890 PRINT @Aaprim:"SEND"
900 INPUT @Aaprim:Thdpbp
910 PRINT "THD Band Pass:        ";Thdpbp;" %"
920   !Set up AA 5001 for VOLTS Function, filters flat, RMS.
930 PRINT @Aaprim:"FUNC THDDB;FILT FLAT;RESP RMS"
940   ! Input a reading from AA 5001.
950 PRINT @Aaprim:"SEND"
960 INPUT @Aaprim:Thdbflat
970 PRINT "THD Flat Response:    ";Thdbflat;" dB"
980   !
990   !
1000   !
1010   !
1020   !
1030   !
1040   !
1050   ! Unlock all instruments on the bus.
1060 CALL "RENOFF"
1070 CALL "RENON"
1080 OFF SRQ
1090 END
1100   ! SRQ Handler
1110 DIM E$(60)
1120 Eflag=0
1130 POLL Addr,Stabyt;Aaprim
1140 GOSUB Addr OF 1160,1200
1150 GO TO 1520
1160 PRINT @Aaprim:"ID?;ERR?"
1170 INPUT @Aaprim:E$
1180 Addr=Aaprim
1190 GO TO 1230
1200 PRINT @Sgprim:"ID?;ERR?"
1210 INPUT @Sgprim:E$
1220 Addr=Sgprim
1230 L=POS(E$,"ERR",1)
1240 Error$=SEG(E$,L,10)
1250 Error=VAL(Error$)
1260 S$=SEG(E$,8,6)
1270 IF S$="AA5001" AND Error=601 THEN
1280    Eflag=1
1290 END IF
1300 IF S$="AA5001" AND Error=701 THEN
1310    Eflag=2
1320 END IF
1330 IF S$="AA5001" AND Error=703 THEN
1340    Eflag=3
1350 END IF
```

```
1360 IF S$="AA5001" AND Error=704 THEN
1370    Eflag=4
1380 END IF
1390 IF Eflag=1 THEN
1400    E$=E$&"Display Overranse"
1410 END IF
1420 IF Eflag=2 THEN
1430    E$=E$&"Insufficient Input Level"
1440 END IF
1450 IF Eflag=3 THEN
1460    E$=E$&"Excessive Input Level"
1470 END IF
1480 IF Eflag=4 THEN
1490    E$=E$&"Unsettled Reading"
1500 END IF
1510 PRINT E$,"ADDRESS = ";Addr,"STATUS = ";Stabyt
1520 RETURN
1530 END
```

4041:

```
100   ! ************************************************************************
110   ! ******************** AA 5001 MEASUREMENT PROGRAM ***********************
120   ! ************************************************************************
130   !
140   ! For 4041: October 5, 1983
150   !
160   ! Copyright (c) 1983 Tektronix, Inc.  All rights reserved.  This
170   ! software is provided on an "as is" basis without warranty of
180   ! any kind.  It is not supported.
190   !
200   ! This program may be reproduced without prior permission, in whole
210   ! or in part, by the original purchaser.  Copies must include the
220   ! above copyright and warranty notice.
230   !
240   ! PURPOSE:
250   ! Makes four different AA 5001 measurements and prints them on the
260   ! 4041 printer.
270   !
280   ! REQUIRED EQUIPMENT:
290   ! AA 5001 Programmable Distortion Analyzer.
300   ! 4041 Controller (V2.0)
310   !
320   ! PROGRAM SEGMENT VARIABLES:
330   ! aaprim          AA 5001 primary address. Factory set to 28.
340   ! aa              AA 5001 logical unit number.
350   ! toleran         tolerance for Delay Until Settled algorithm in AA 5001.
360   ! counts          number of counts for DUS algorithm in AA 5001.
370   ! points          number of readings to be within tolerance and points.
380   ! voltshp         AA 5001 level reading in volts RMS with high pass filter.
390   ! dbmlp           AA 5001 level reading in dBm with low pass filter.
400   ! thdpbp          AA 5001 THD reading in percent with bandpass filter.
410   ! thdbflat        AA 5001 THD reading in dB with no filters in.
420   !
430   ! OPERATING INSTRUCTIONS:
440   ! Connect output of DUT to input of AA 5001. Address of AA 5001
450   ! must be set to 28.
460   ! If address is different from this factory set address, then
470   ! variable aaprim ( AA 5001 primary address ) must be changed
480   ! accordingly.
490   !
500   ! ERRORS:
510   ! No GPIB or tape error handlers are linked so 4041 prints default system
520   ! error messages and stops if such errors occur (instrument power is off
530   ! or tape capacity exceeded, etc.).
540   !
550   ! INSTRUMENT CONTROL:
560   ! Polls all instruments on selected port.
570   !
580   ! ************************************************************************
590   ! Begin main program segment
600     Init all
610     Select "gpib0:"
620     On srq then call handler
630     Integer aaprim,aa,points
640     Aaprim=28
650     Sgprim=25
660     Aa=280
670     Toleran=0.1
680     Counts=1
690     Points=6
700     Open #aa:"gpib0(pri="&str$(aaprim)&"):"
710     Open #2000:"prin:"
720     Enable srq
```

```
730     !
740     ! Initialize the AA 5001.
750       Wbyte atn(mta,aaprim+32),"INIT",eoi,atn(unt,unl)
760     ! Lock out the AA 5001 front panel.
770       Wbyte llo
780     ! Set up AA 5001 to delay sending a readings until settled.
790     ! Set tolerance, number of counts, and number of points for DUS algorithm.
800       Print #aa:"DUS ON;TOL";toleran,"COUNTS";counts,"POINTS";points
810       Print using "FA/FA/" #2000:"AA 5001 Measurements","--------------------"
820     ! Set up AA 5001 for VOLTS Function, filter high pass, RMS Response.
830       Print #aa:"FUNC VOLTS;FILT HP;RESP RMS"
840     ! Input a reading from AA 5001.
850       Input prompt "SEND" #aa:voltshp
860       Print using "FA/6.3GFA" #2000:"Level High Pass:",voltshp," Volts"
870     ! Set up AA 5001 for DBM Function, filter low pass, RMS Response.
880       Print #aa:"FUNC DBM;FILT LP;RESP RMS"
890     ! Input a reading from AA 5001.
900       Input prompt "SEND" #aa:dbmlp
910       Print using "FA/5.1GFA" #2000:"Level Low Pass:",dbmlp," dBm"
920     ! Set up AA 5001 for THD in percent Function, filter bandpass, RMS Response.
930       Print #aa:"FUNC THDPCT;FILT BP;RESP RMS"
940     ! Input a reading from AA 5001.
950       Input prompt "SEND" #aa:thdpbp
960       Print using "FA/8.4GFA" #2000:"THD Band Pass:",thdpbp," %"
970     ! Set up AA 5001 for THD in dB Function, filters flat, RMS Response.
980       Print #aa:"FUNC THDDB;FILT FLAT;RESP RMS"
990     ! Input a reading from AA 5001.
1000      Input prompt "SEND" #aa:thdbflat
1010      Print using "FA/5.1GFA" #2000:"THD Flat Response:",thdbflat," dB"
1020    !
1030    ! Unlock all instruments on the bus.
1040      Wbyte ren(0),ren(1)
1050      End
1100  Sub handler local e$,statbyt,addr,eflag
1110      Dim e$ to 60
1120      Eflag=0
1130      Poll statbyt,addr
1140      Input prompt "ID?;ERR?" #addr:e$
1150      If seg$(e$,8,6)="AA5001" and valc(e$,pos(e$,"ERR",1))=601 then eflag=1
1160      If seg$(e$,8,6)="AA5001" and valc(e$,pos(e$,"ERR",1))=701 then eflag=2
1170      If seg$(e$,8,6)="AA5001" and valc(e$,pos(e$,"ERR",1))=703 then eflag=3
1180      If seg$(e$,8,6)="AA5001" and valc(e$,pos(e$,"ERR",1))=704 then eflag=4
1190      If eflag=1 then e$=e$&"Display Overrange"
1200      If eflag=1 then e$=e$&"Insufficient Input Level"
1210      If eflag=1 then e$=e$&"Excessive Input Level"
1220      If eflag=1 then e$=e$&"Unsettled Reading"
1230      Print using "FAL=FA2DL=FA3DL" #2000:e$,"ADDRESS = ",addr,"STATUS = ",statbyt
1240      Resume
1250      End
```

```
AA 5001 Measurements
--------------------

Level High Pass:
 1.564 Volts
Level Low Pass:
  6.2 dBm
THD Band Pass:
  0.0024 %
THD Flat Response:
-89.4 dB
```

4788-03

Fig. 4. *Printer output from 4041 sample measurement program.*

ASCII & GPIB CODE CHART

B7 B6 B5 BITS / B4 B3 B2 B1	ø ø ø	ø ø 1	ø 1 ø	ø 1 1	1 ø ø	1 ø 1	1 1 ø	1 1 1
	CONTROL		NUMBERS SYMBOLS		UPPER CASE		LOWER CASE	
ø ø ø ø	0 NUL 0 0	20 DLE 10 16	40 0 SP 20 32	60 16 0 30 48	100 0 @ 40 64	120 16 P 50 80	140 0 ` 60 96	160 16 p 70 112
ø ø ø 1	1 GTL SOH 1 1	21 LLO DC1 11 17	41 1 ! 21 33	61 17 1 31 49	101 1 A 41 65	121 17 Q 51 81	141 1 a 61 97	161 17 q 71 113
ø ø 1 ø	2 STX 2 2	22 DC2 12 18	42 2 " 22 34	62 18 2 32 50	102 2 B 42 66	122 18 R 52 82	142 2 b 62 98	162 18 r 72 114
ø ø 1 1	3 ETX 3 3	23 DC3 13 19	43 3 # 23 35	63 19 3 33 51	103 3 C 43 67	123 19 S 53 83	143 3 c 63 99	163 19 s 73 115
ø 1 ø ø	4 SDC EOT 4 4	24 DCL DC4 14 20	44 4 $ 24 36	64 20 4 34 52	104 4 D 44 68	124 20 T 54 84	144 4 d 64 100	164 20 t 74 116
ø 1 ø 1	5 PPC ENQ 5 5	25 PPU NAK 15 21	45 5 % 25 37	65 21 5 35 53	105 5 E 45 69	125 21 U 55 85	145 5 e 65 101	165 21 u 75 117
ø 1 1 ø	6 ACK 6 6	26 SYN 16 22	46 6 & 26 38	66 22 6 36 54	106 6 F 46 70	126 22 V 56 86	146 6 f 66 102	166 22 v 76 118
ø 1 1 1	7 BEL 7 7	27 ETB 17 23	47 7 ' 27 39	67 23 7 37 55	107 7 G 47 71	127 23 W 57 87	147 7 g 67 103	167 23 w 77 119
1 ø ø ø	10 GET BS 8 8	30 SPE CAN 18 24	50 8 (28 40	70 24 8 38 56	110 8 H 48 72	130 24 X 58 88	150 8 h 68 104	170 24 x 78 120
1 ø ø 1	11 TCT HT 9 9	31 SPD EM 19 25	51 9) 29 41	71 25 9 39 57	111 9 I 49 73	131 25 Y 59 89	151 9 i 69 105	171 25 y 79 121
1 ø 1 ø	12 LF A 10	32 SUB 1A 26	52 10 * 2A 42	72 26 : 3A 58	112 10 J 4A 74	132 26 Z 5A 90	152 10 j 6A 106	172 26 z 7A 122
1 ø 1 1	13 VT B 11	33 ESC 1B 27	53 11 + 2B 43	73 27 ; 3B 59	113 11 K 4B 75	133 27 [5B 91	153 11 k 6B 107	173 27 { 7B 123
1 1 ø ø	14 FF C 12	34 FS 1C 28	54 12 , 2C 44	74 28 < 3C 60	114 12 L 4C 76	134 28 \ 5C 92	154 12 l 6C 108	174 28 |* 7C 124
1 1 ø 1	15 CR D 13	35 GS 1D 29	55 13 − 2D 45	75 29 = 3D 61	115 13 M 4D 77	135 29] 5D 93	155 13 m 6D 109	175 29 } 7D 125
1 1 1 ø	16 SO E 14	36 RS 1E 30	56 14 . 2E 46	76 30 > 3E 62	116 14 N 4E 78	136 30 ^ 5E 94	156 14 n 6E 110	176 30 ~ 7E 126
1 1 1 1	17 SI F 15	37 US 1F 31	57 15 / 2F 47	77 UNL ? 3F 63	117 15 O 4F 79	137 UNT _ 5F 95	157 15 o 6F 111	177 DEL (RUBOUT) 7F 127
	ADDRESSED COMMANDS	UNIVERSAL COMMANDS	LISTEN ADDRESSES		TALK ADDRESSES		SECONDARY ADDRESSES OR COMMANDS (PPE)	(PPD)

KEY

octal 25 PPU / NAK / hex 15 21 — GPIB code, ASCII character, decimal

*| on some keyboards or systems

Tektronix
COMMITTED TO EXCELLENCE

REF: ANSI STD X3. 4-1977
IEEE STD 488-1978
ISO STD 646-1973

TEKTRONIX INSTRUMENTATION SOFTWARE LIBRARY

Utility Software for TM 5000 Instruments

Utility Software is available from Tektronix, Inc. for TM 5000 Instruments. This software consists of a set of subroutines and subprograms that perform common instrument functions over the GPIB such as data acquisition, front-panel set-up, etc. These routines are designed to be easily integrated into your application programs. And since they are small and well documented, the routines are easy to modify to suit your particular applications. Refer to the current Tektronix Instrumentation Software Library Catalog for instrument options, ROM packs, and other required equipment.

The following Utility Software was available when this Instrument Interfacing Guide was printed. Other software may be available; contact your local Tektronix Field Office for further information.

Tektronix Description	Part No.
TM 5000/4041 Utility Software (DC-100 tape)	062-6958-01
TM 5000/4052A Utility Software (DC-300 tape)	062-6957-01

Ordering Utility Software (U.S. Only)

Your local Tektronix Field Office has the current prices for software available from the Tektronix Instrumentation Software Library.

Order Tektronix Instrumentation Software Library programs from Tektronix Central Parts Ordering by using the toll-free number serving your area. The following map identifies the geographical regions in the U.S. and the toll-free number serving each region.

Call the toll-free number serving your area and give the Customer Service Representative the Tektronix nine-digit part number and name of the software package you want to order. If you have any questions about the software, call your local Tektronix Field Office.

Ordering Utility Software (Outside the U.S.)

Outside of the U.S., order Tektronix Instrumentation Software Library programs through your local Tektronix sales office or from the Tektronix Instrumentation Software Library order point serving your area. Refer to the following list for the applicable library order point.

Africa, Europe, Middle East

Contact local Tektronix sales office.

Australia

Tektronix Instrumentation Software Library
Tektronix Australia Pty. Limited
Sydney
80 Waterloo Road
North Ryde, N.S.W. 2113

Canada

Tektronix Instrumentation Software Library
Tektronix Canada Ltd.
P.O. Box 6500
Barrie, Ontario
Canada L4M 4V3

Caribbean, Latin America, and Far East (except Japan)

Tektronix Instrumentation Software Library
Export Marketing
Tektronix, Inc.
P.O. Box 500
Beaverton, OR 97077
U.S.A.

Japan

Tektronix Instrumentation
Software Library
Sony/Tektronix
Corporation
9-31 Kitashinagawa-5
Tokyo 141 Japan

Program Library

The Tektronix Instrumentation Software Library includes over 200 software programs for a variety of Tektronix programmable instruments and controllers. The Library Catalog provides abstracts of the available software. Programs are available as ready-to-load media or as listings (see Catalog). For a copy of the latest catalog, contact your local Tektronix Field Office or representative and ask for Tektronix Instrumentation Software Library Catalog #99W-5293.

Program Contributions

If you have a program which you would like to submit to the Tektronix Instrumentation Software Library, we will send you, in exchange, one software package of your choice from the Customer/User Software portion of the Program Library (see current library catalog). Submitted programs must use Tektronix programmable instruments and must meet certain coding and documentation standards.

To contribute a program, submit a copy of the program on media along with a listing and a Tektronix Instrument Software Library release form (see current library catalog). If the program was created as part of your employment, the release must be signed by an authorized representative of your employer. Acceptance of the program is subject to review of the Tektronix Instrumentation Software Library staff.

For further information on submitting a program or for information about coding and documentation standards, contact:

Tektronix Instrumentation Software Library
Tektronix, Inc.
Group 157, 54-016
P.O. Box 500
Beaverton, OR 97077

Software Warranty

Tektronix warrants that the media (tapes, disks, ROMs, etc.) on which Software Products are furnished and the encoding of the programs on the media will be free from defects in materials and workmanship for a period of three (3) months from the date of shipment. If any such medium or encoding proves defective during the warranty period, Tektronix will provide a replacement in exchange for the defective medium. Except as to the media on which Software Products are furnished, Software Products are provided "as is" without warranty of any kind, either expressed or implied. Tektronix does not warrant that the functions contained in the programs will meet Customer's requirements or that the operations of the programs will be uninterrupted or error-free.

In order to obtain service under this warranty, Customer must notify Tektronix of the defect before the expiration of the warranty period. If Tektronix is unable to provide a replacement that is free from defects in materials and workmanship within a reasonable time thereafter, Customer may terminate the license for the Software Product and return the Software Product with the associated materials for credit or refund.

Tektronix disclaims any implied warranties of merchantability or fitness for a particular purpose. Tektronix' responsibility to replace defective media or refund customer's payment is the sole and exclusive remedy provided to the customer for breach of this warranty. Tektronix will not be liable for any indirect, special, incidental, or consequential damages irrespective of whether Tektronix has advance notice of the possibility of such damages.

Tek Lit. 76W5396