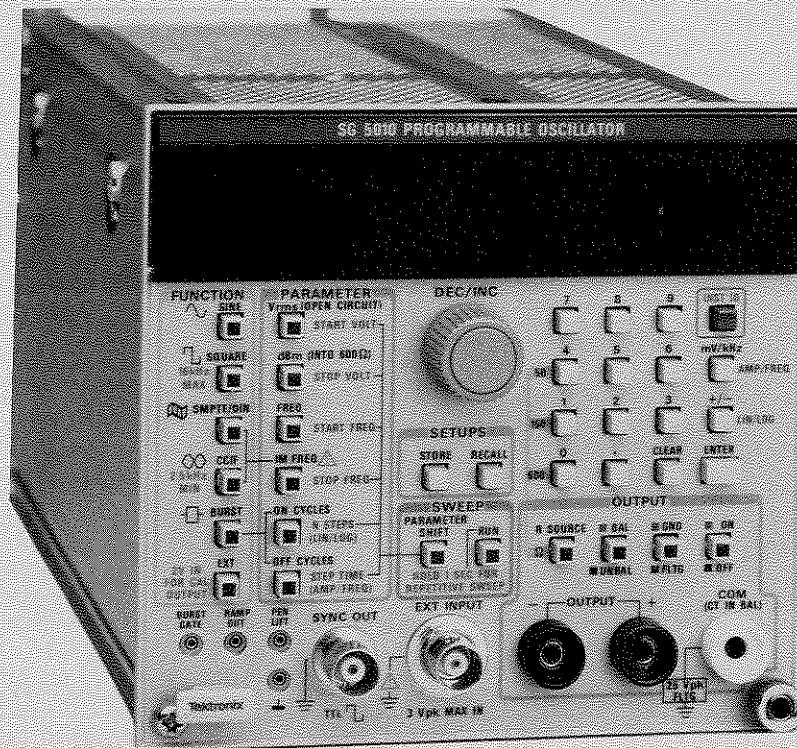


SG 5010 Instrument Interfacing Guide



4790-1

This interfacing guide is designed to help you get started using the SG 5010 Programmable 160 kHz Oscillator with a GPIB controller as quickly and easily as possible. This guide tells you how to set up the SG 5010 for GPIB operation and explains how to communicate with the SG 5010 with a variety of controllers. Sample programs for these controllers are also included.

This guide does not take the place of the operators manual or other documentation supplied with the SG 5010 and your system controller. More complete information in this other documentation will help you get the full benefit of the SG 5010's programmable capabilities.

Setting Up the SG 5010 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 SG 5010 and controller are the only instruments on the bus.

Checking the GPIB Address and Terminator. The SG 5010 primary address is displayed when you press the INST ID button. A decimal point in the display indicates that the message terminator is set for EOI Only or LF with EOI (no decimal point indicates EOI-Only).

The SG 5010 is supplied from the factory set to an address of 25 and to EOI-Only for the message terminator.

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Product Group 76
First Printing SEP 1983

Setting the Address and Terminator. The address and message terminator are set by pushing the front panel RECALL, then INST ID button, then the desired two digits on the number key pad on the SG 5010 front panel. The decimal point switch is pressed for EOI or not pressed for EOI ONLY. After completing the address and message terminator selection, press the ENTER button. Other switch or strap-selectable options in the SG 5010 are explained in the Operators Manual.

Valid primary addresses include the range of 0 to 30. (31 effectively disables the SG 5010 from communicating on the GPIB.) If your controller reserves an address for itself, do not set the SG 5010 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-up, but may be programmed to use any primary address. The SG 5010 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 SG 5010 still recognizes EOI as a terminator and transmits EOI concurrently with the LF character to terminate a message.)

Programming The SG 5010

SG 5010 Power-On

The SG 5010 performs a self-test and goes to its default settings at power-on.

Self-Test. During the self-test, all of the front panel LEDs are on. If an internal error is detected, the SG 5010 continuously displays a three-digit error code. See the operators manual for the meaning of any code displayed. Refer the error conditions to qualified service personnel.

Power-On Settings. Following a complete self-test, the SG 5010 goes to local state with default settings. The default settings are shown in Table 1 (and defined in Table 2). These settings are restored any time the INIT command is executed.

Power-On SRQ. The SG 5010 asserts SRQ to report power-on status after completing the self-test. This can be handled with a serial poll, although the SG 5010 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 4052A 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'.

Table 1
SG 5010 Power-On Settings

Header	Argument
AMPL	1 VRMS
BAL	ON
CLI	OFF
DISPLAY	VRMS
DT	OFF
FREQ	10000
FUNC	SINE
GND	OFF
IMF	60
NSTEP	30,LOG
OFFCYC	90
ONCYC	10
OPC	OFF
OUT	OFF
OVER	OFF
PLI	OFF
RSRC	600
RQS	ON
STARTF	20
STOPF	20000
STARTV	0.1
STOPV	10.0
SWEEP	OFF
STEPT	1,FREQ
USER	OFF

SG 5010 Messages

Commands are provided to control SG 5010 settings, cause SG 5010 actions, or request information. These commands are listed in Table 2. SG 5010 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 either the comma or colon. SG 5010 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
SG 5010 Commands and Descriptions
 [] = Optional, <> = Defined

Header	Argument	Description
AMplitude	<num> [:<units>]	Sets amplitude and units of output signal. Units: VPP, VRMS, DBM, or DBU. If undefined, the units are Vrms if previously set to Vp-p, Vrms, or DBU; otherwise <units> are dBm.
AMplitude?		Returns amplitude and units.
BALance	[ON]	Selects balanced output.
BALance	OFF	Selects unbalanced output.
BAI?		Response indicates signal output is balanced or unbalanced.
CLi	ON	Enables assertion of SRQ when instrument goes into or out of current limit.
CLi	OFF	Disables assertion of SRQ when instrument goes into or out of current limit.
CLi?		Response indicates the current limit interrupt state (on or off).
CUrrent?		Returns "CURR <num>;", where <num> is 0 if instrument is not current limited; <num> is 1 if instrument is current limited.
DBm	<num>	Sets amplitude to specified dBm value.
DBm?		Returns amplitude in dBm.
DBU	<num>	Sets amplitude to equivalent Vrms value.
DBU?		Returns amplitude in dBu.

Table 2 (cont)
SG 5010 Commands and Descriptions
 [] = Optional, <> = Defined

Header	Argument	Description
DISplay	Dbm	Displays amplitude setting in dBm.
DISplay	Freq	Displays frequency setting.
DISplay	Imfreq	Displays IM frequency setting.
DISplay	Nsteps	Displays number of steps set for sweep.
DISplay	ONcycles	Displays number of <i>on</i> cycles for burst.
DISplay	OFFcycles	Displays number of <i>off</i> cycles for burst.
DISplay	RSource	Displays source impedance setting.
DISplay	RSrc	Displays source impedance setting.
DISplay	STARTFreq	Displays sweep mode setting for start frequency.
DISplay	STARTVolts	Displays starting sweep amplitude in Vrms.
DISplay	STEptime	Displays time per sweep step.
DISplay	STOPFreq	Displays sweep mode setting for stop frequency.
DISplay	STOPVolts	Displays stopping sweep amplitude in Vrms.
DISplay	Vrms	Displays amplitude setting in Vrms.
DT	Gate	A <GET> interface message toggles the burst gate, if the instrument is set to FUNC BURST, OFFCYC 0, and no external signal is connected to the BURST GATE input. While BURST GATE is unasserted (floating high), the instrument outputs a sine wave.
DT	Off	Disables all DT (Device Trigger) functions.

Table 2 (cont)
SG 5010 Commands and Descriptions
[] = Optional, <> = Defined

Header	Argument	Description
DT	Set	Causes instrument to wait for <GET> interface message before updating instrument settings, except for SWEEP ON, SWEEP SINGLE, and SWEEP REPEAT, which are executed when received (<GET> not required).
DT	SWEEP	A <GET> interface message causes instrument to start a single sweep sequence.
DT	Trig	A <GET> interface message initiates a single burst, if instrument is set to FUNC BURST, OFFCYC 99999, and no external signal is connected to the BURST GATE input.
DT?		Response indicates which DT function is enabled.
ERRMsg?		Returns an event code and a brief description of the event. If RQS is ON, the code indicates the most recent event. If RQS is OFF, the code indicates the highest priority event that has occurred.
ERRor? EVEnt?		Same as ERRMsg except that the event description is eliminated.
FLoat FLt		Sets instrument to floating signal output.
FRequency	<num>	Sets frequency (main frequency) for all functions except EXT.

Table 2 (cont)
SG 5010 Commands and Descriptions
[] = Optional, <> = Defined

Header	Argument	Description
FRequency?		Returns frequency setting (main frequency).
[FUnction]	Sine	Selects the sine wave for output.
[FUnction]	SQuare	Selects the square wave for output.
[FUnction]	SMpte [:<ratio>]	Selects SMPTE/DIN signal for output and specifies amplitude ratio between low and high frequency tones. Valid values for <ratio> are 1 or 4; 4 is the default ratio.
[FUnction]	CCif	Selects CCIF signal for output.
[FUnction]	BURst [:<ratio>]	Selects sine wave burst signal for output and specifies amplitude of the off cycles (as a percent of the on cycles amplitude). Valid percent is 0 or 10; default percent is 0.
[FUnction]	EXternal	Selects signal at EXT INPUT connector as the output.
FUnction?		Returns enabled function (and number indicating SMPTE/DIN ratio or burst percent, if applicable).
GAte?		Returns "GATE <num>;", where <num> is 0 if signal at BURST GATE connector is unasserted; <num> is 1 if BURST GATE is asserted.
GRound GNd	[ON] [ON]	Sets instrument to grounded signal output.
GRound GNd	OFF OFF	Sets instrument to floating signal output.

Table 2 (cont)
SG 5010 Commands and Descriptions
 [] = Optional, <> = Defined

Header	Argument	Description
GRound? GNd?		Response indicates whether signal output is grounded or floating.
HElp?		Returns a string list of all SG 5010 command headers.
IDentify?		Returns the instrument type, Tektronix Codes and Formats version, and the instrument firmware version.
IMfreq	<num>	Sets IM frequency for SMPTE/DIN and CCIF functions. Valid frequencies are 40, 50, 60, 80, 100, 125, 250, and 500 Hz.
IMF?		Returns IM frequency setting.
INit		Initializes instrument to the following settings:
LLset	<binblk>	Sets instrument to settings stored in <binblk>, except DT, CLI, OVER, OPC, PLI, RQS, and USEREG.
LLset?		Returns instrument settings in binary format.
LOck?		Returns "LOCK <num>," where <num> is 1 if instrument has not been in phase lock for more than 1 ms; <num> is 0 if instrument is in phase lock.
Mode	Ampl	Sets sweep to amplitude mode.
Mode	Freq	Sets sweep to frequency mode.

Table 2 (cont)
SG 5010 Commands and Descriptions
 [] = Optional, <> = Defined

Header	Argument	Description
Mode?		Returns sweep mode (amplitude or frequency).
NBurst	<num>	Specifies number of <i>on</i> cycles for burst; sets number of <i>off</i> cycles to infinity (99999), for single burst mode. Valid range for <i>on</i> cycles is 1 to 65535. A single burst is triggered by assertion (floating high) of the signal of the BURST GATE input connector.
NSteps	<num> [, <type>]	Sets number of sweep steps. Valid range is 1 to 99. Type specifies linear (LIN) or logarithmic (LOG) sweep; default type is the previously specified type.
NSteps?		Returns number of sweep steps and type.
OFFCycles	<num>	Specifies number of <i>off</i> cycles for burst (0 for gated burst; 1 to 65535 for repetitive burst; 99999 for single burst). Gated and single burst are triggered when the signal at the BURST GATE input connector is asserted (high).
OFFCycles?		Returns number of <i>off</i> cycles for burst.
ONCycles	<num>	Specifies number of <i>on</i> cycles for burst. Valid range is 1 to 65535.
ONCycles?		Returns number of <i>on</i> cycles.
OPc	ON	Enables operation complete interrupt; instrument asserts SRQ when it completes one sweep.

Table 2 (cont)
SG 5010 Commands and Descriptions
 [] = Optional, <> = Defined

Header	Argument	Description
OPc	Off	Disables operation complete interrupt; instrument does not assert SRQ when it completes one sweep.
OPc?		Returns setting of operation complete interrupt: "OPC ON;" or "OPC OFF;".
OVerrange	ON	Enables sweep overrange interrupt; instrument asserts SRQ when the sweep exceeds a limit of a sweep parameter.
OVerrange	Off	Disables sweep overrange interrupt; instrument does not assert SRQ when the sweep exceeds a limit of a sweep parameter.
OVerrange?		Returns setting of sweep overrange interrupt: "OVER ON;" or "OVER OFF;".
OUtput	ON	Turns on signal output.
OUtput	Off	Turns off signal output.
OUt?		Response indicates signal output state (on or off).
PLi	ON	Enables phase lock interrupt; instrument asserts SRQ when it goes out of phase lock from a reportable out-of-phase lock condition.
PLi	Off	Disables phase lock interrupt; instrument does not assert SRQ when it goes out of phase lock for more than 1 ms, or into phase lock after being out for more than 1 ms.

Table 2 (cont)
SG 5010 Commands and Descriptions
 [] = Optional, <> = Defined

Header	Argument	Description
PLi?		Returns setting of phase lock interrupt: "PLI ON;" or "PLI OFF;".
REcall	<num>	Sets instrument to the settings recalled from specified storage location. Location numbers are 0 through 9.
RQs	ON	Enables service request interrupt.
RQs	Off	Disables service request interrupt.
RQs?		Returns setting of service request interrupt: "RQS ON;" or "RQS OFF;".
RSource	<num>	Sets source impedance.
RSrc	<num>	Valid impedances are 50, 150, and 600 Ω.
RSource?		Returns source impedance setting.
RSrc?		
RUnn?		Returns 0 (sweep not running) or 1 (sweep running).
SETtings?		Returns a string list of current instrument settings.
STARTFreq	<num>	Sets the start frequency for sweep operation.
STARTFreq?		Returns start frequency setting.
STARTVolts	<num>	Sets start amplitude for sweep operation, in Vrms.
STARTVolts?		Returns start amplitude setting in Vrms.
STEptime	<num> [, <mode>]	Sets time per sweep step and sweep mode. Valid range for time is .1 to 25.0 seconds with .1 second resolution. Sweep mode is either FREQUENCY or AMPLITUDE; default mode is the previously specified mode.

Table 2 (cont)
SG 5010 Commands and Descriptions
 [] = Optional, <> = Defined

Header	Argument	Description
STeptime?		Returns time per sweep step and sweep mode.
STOPFreq	<num>	Sets stop frequency for sweep operation.
STOPFreq?		Returns stop frequency setting.
STOPVolts	<num>	Sets stop amplitude for sweep operation, in Vrms.
STOPVolts?		Returns stop amplitude in Vrms.
STORe	<num> [, <num>...]	Stores the current settings in specified storage location(s) (except CLI, DT, OVER, OPC, PLI, RQS, USEREQ0). Locations are 0 through 9.
STORe	<num>: <binblk>	Stores <binblk> settings data in specified storage location (0 through 9).
STORe?	<num> [, <num>...]	Outputs settings stored in specified location(s) 0 through 9, using the format STORE <num>:<binblk>;.
SWEEP	ON	Starts a single sweep sequence.
SWEEP	Single	
SWEEP	Repeat	Starts a repetitive sweep sequence.
SWEEP	OFF	Stops the sweep.
TEst?		Initiates instrument self test; returns 0 (no errors), or event codes of detected failures.
TYPe	Lin	Sets sweep type to linear sweep.
TYPe	LOg	Sets sweep type to logarithmic sweep.
TYPe?		Returns sweep type setting.

Table 2 (cont)
SG 5010 Commands and Descriptions
 [] = Optional, <> = Defined

Header	Argument	Description
UNbalance		Sets instrument to unbalanced signal output.
USereq	ON	Enables user request interrupt; instrument asserts SRQ when front panel INST ID button is pushed.
USereq	OFF	Disables user request interrupt; instrument does not assert SRQ when front panel INST ID button is pushed.
USereq?		Response indicates the user request interrupt state (on or off).
VPP	<num>	Sets amplitude to equivalent Vrms value of argument.
VPP?		Returns amplitude in V p-p units.
Vrms	<num>	Sets amplitude to specified Vrms value.
Vrms?		Returns amplitude in Vrms.

Sending Messages to the SG 5010

Most GPIB controllers provide a high-level statement that allows you to transfer device-dependent messages to the SG 5010. In the 4050-Series and the 4041, it's the PRINT statement.

4050-Series controller:

```
180 PRINT @25:"FUNC SINE;FREQ 6.7E+3;OUT ON"
```

4041 controller:

```
180 Print #25:"FUNC SINE;FREQ 6.7E+3;OUT ON"
```

A useful variation assigns the SG 5010 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 SG 5010 set to other addresses by changing only the statement that assigns the variable.

4050-Series:

```
200 LET S=25
210 PRINT @5:"FUNC SINE;FREQ 6.7E+3;OUT ON"
```

4041:

```
200 Let ss=25
210 Print #ss:"FUNC SINE;FREQ 6.7E+3;OUT ON"
```

Here's how to use the 4041 OPEN statement to allow such flexibility with a logical unit (LU) number instead of a variable for the SG 5010 address:

```
230 Open #100:"GPIB(Pr1=25):"
240 Print #100:"FUNC SINE;FREQ 6.7E+3;OUT ON"
```

Notice that the SG 5010 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. 1. This suggests that once you understand your controller's input/output statements, it's just a matter of plugging in the SG 5010 commands you need.

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

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Fig. 1. 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 for a particular controller.

Getting SG 5010 Settings Information

SG 5010 queries (such as SET?, FREQ?, or ID?) prepare the instrument for data output, but do not start such output. The SG 5010 waits until it sees its talk address to begin sending the requested data. This is accomplished by the INPUT statement.

4050-Series:

```
260 PRINT @25:"FREQ?"
270 INPUT @25:F1
```

4041:

```
260 Input #25 prompt "FREQ?":freq
```

All instrument settings can be obtained in one message. Just dimension a string large enough (350 characters is plenty) and input the settings string.

4050-Series:

```
300 DIM S$(280)
310 PRINT @25:"SET?"
320 INPUT @25:S$
```

4041:

```
300 Dim settings$ to 280
310 Input #25 prompt "SET?":settings$
```

You can restore the settings you input from the SG 5010 by sending back the settings string.

4050-Series:

```
340 PRINT @25:S$
```

4041:

```
340 Print #25:settings$
```

The "TALKED WITH NOTHING TO SAY" Response

The SG 5010 can respond with a single byte with all bits set (Hex FF or Decimal 255) when it is talk addressed but has nothing to say (has not been queried). This feature prevents the SG 5010 from hanging

up the GPIB handshake and halting bus traffic. If the controller executes an input statement with a numeric variable target, the value of the variable will be left unchanged when the byte is sent by the SG 5010. If the variable has not been assigned a value before a "Talked With Nothing to Say" response is received, it may still be undefined after input. Subsequent references to this undefined variable may cause errors during run time. Good programming practices suggest that the variable should be defined before such an input is attempted.

Using SG 5010 Interrupts

Programmable interrupts are provided in the SG 5010 to inform the controller of asynchronous events such as command errors, syntax errors, or instrument events. The status bytes returned in response to a serial poll and the error codes returned in response to an error query (ERR?) are shown in Table 3. The error query obtains more detail in the case of abnormal 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.

Table 3
ERROR QUERY AND STATUS INFORMATION

ABNORMAL EVENTS			
Event	Priority	Error Query Response or Displayed Code	Serial Poll Response*
Command Errors:			
Invalid command header	2	101	97
Header delimiter error	2	102	97
Argument error	2	103	97
Argument delimiter error	2	104	97
Missing argument		106	97
Invalid message unit delimiter	2	107	97
Binary block checksum error	2	108	97
Binary block byte-count error	2	109	97
Execution Errors:			
Not executable in local mode	3	201	98
Settings lost due to rtl	3	202	98
Input and output buffers full	3	203	98
Argument out-of-range	3	205	98
Group Execute Trigger ignored	3	206	98
Amplitude/Balance conflict	3	261	98
Amplitude/RSource conflict	3	262	98
Amplitude/Balance/RSource conflict	3	263	98
Frequency/Function conflict	3	264	98
Sweep Parameter conflict	3	265	98

*If the GPIB message processor is busy, the number returned for a serial poll is 16 (decimal) higher than the number listed.

Table 3 (cont)

ABNORMAL EVENTS

Event	Priority	Error Query Response or Displayed Code	Serial Poll Response ^a
Internal Errors:			
Interrupt fault	4	301	99
System error	4	302	99
Output overloaded ^b	5	309	99
Analog power supply error ^b	6	310	99
Phase lock error ^b	7	315	99
Current limit error ^b	8	319	99
Sine wave oscillator error ^b	9	320	99
Oscillator 1 k band error ^b	10	321	99
Oscillator 10 k band error ^b	11	322	99
Oscillator 100 k band error ^b	12	323	99
Square wave generator error ^b	13	324	99
Burst generator error ^b	14	325	99
Burst lo byte counter error ^b	15	326	99
Burst hi byte counter ^b	16	327	99
Burst gate line asserted error ^b	17	328	99
Burst gate line unasserted error ^b	18	329	99
40 Hz IM Freq error ^b	19	330	99
50 Hz IM Freq error ^b	20	331	99
60 Hz IM Freq error ^b	21	332	99
80 Hz IM Freq error ^b	22	333	99
100 Hz IM Freq error ^b	23	334	99

^aIf the GPIB message processor is busy, the number returned for a serial poll is 16 (decimal) higher than the number listed.

^bThis error is also displayed on the instrument front panel.

Table 3 (cont)

ABNORMAL EVENTS

Event	Priority	Error Query Response or Displayed Code	Serial Poll Response ^a
125 Hz IM Freq error ^b	24	335	99
250 Hz IM Freq error ^b	25	336	99
500 Hz IM Freq error ^b	26	337	99
System RAM failure ^c		340	
GPIB address setting cell error ^c		348	
Power-up stored settings cell error ^b	27	349	99
Stored settings cell 0 error ^b	27	350	99
Stored settings cell 1 error ^b	27	351	99
Stored settings cell 2 error ^b	27	352	99
Stored settings cell 3 error ^b	27	353	99
Stored settings cell 4 error ^b	27	354	99
Stored settings cell 5 error ^b	27	355	99
Stored settings cell 6 error ^b	27	356	99
Stored settings cell 7 error ^b	27	357	99
Stored settings cell 8 error ^b	27	358	99
Stored settings cell 9 error ^b	27	359	99
8000 ROM placement error ^c		368	
C000 ROM placement error ^c		372	
8000 ROM checksum error ^c		388	
C000 ROM checksum error ^c		392	
Execution Warning:			
Signature analysis mode ^c		521	

^aIf the GPIB message processor is busy, the number returned for a serial poll is 16 (decimal) higher than the number listed.

^bThis error is also displayed on the instrument front panel.

^cThis error is only displayed on the instrument front panel.

Table 3 (cont)

NORMAL EVENTS

Event	Priority	Error Query Response or Displayed Code	Serial Poll Response ^a
System Events:			
Power-up	1	401	65
Operation complete	28	402	66
ID user request	30	403	67
No errors or events		0	128
Device Dependent Events:			
Sweep step out-of-range	29	702	193
Out of lock	29	731	194
Into lock	29	732	195
Out of current limit	29	733	196
Into current limit	29	734	197

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.

4050-Series with 405XR14 rompack:

```

120 ON SRQ THEN 1000
130 CALL "SRQON"
140 REM
150 REM
160 REM          MAIN PROGRAM HERE
170 REM
180 REM
990 REM SRQ HANDLER FOR ADDRESS 25 ONLY
1000 POLL I1,S;25
1010 PRINT "STATUS=";S
1020 PRINT @25:"ERRMSG?"
1030 INPUT @25:E$
1040 PRINT E$
1050 RETURN

```

4041-Series:

```

120   On sra then sosub dopoll
130   Enable sra
900   Stop "PROGRAM END"
990   ! SRQ HANDLER FOR ADDRESS 25 ONLY
1000 Dopoll:   poll stabyt,addr;25
1010   Print "STATUS=";stabyt
1020   Input #addr prompt "ERRMSG?";errm$
1030   Print errm$
1040   Resume
1050   End

```

SG 5010 Response to Interface Messages

The following program sequences show various interface messages transmitted to the SG 5010.

^aIf the GPIB message processor is busy, the number returned for a serial poll is 16 (decimal) higher than the number listed.

4050-Series with 405XR14 rompack:

```

550 REM      SG 5010 primary address (factory set to 25) is variable A.
560 REM
570 LET A=25
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:

```

130 Pri_addr=25 !      primary bus address for SG 5010
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 sti(pri_addr),atn(unl) ! Send MLA, Go To Local, UNL
310 !
320 Trisser:  wbyte set(pri_addr),atn(unl) ! Send MLA, Group Execute
330 !                                     Trisser, UNL
340 Loclstat: wbyte ren(0),ren(1) !      Pulse unassert REN line
350 !
360 End

```

The SG 5010 responds to DCL and SDC 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 causes previously received settings to be executed or triggers outputs in TRIGGER, SWEEP, or BURST modes when the instrument receives the message while listen addressed. GET is used after the DT command has been sent.

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 SG 5010 Operators Manual for a full discussion of how the instrument responds to interface messages.

Sample Command Program

The following programs execute a series of SG 5010 commands to illustrate GPIB control with programming commands and bus interface messages.

4050-Series with 405XR14 rompack:

```

100 ! ::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
110 ! ::::::::::::::: SG 5010 / 4052A COMMAND PROGRAM ::::::::::::::
120 ! ::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
130 !
140 ! July 11, 1983
150 !
160 ! Copyright (c) 1983, Tektronix, Inc. All rights reserved.
170 ! This software is provided on an "as is" basis without
180 ! warranty of any kind. It is not supported.
190 !
200 ! This software may be reproduced without prior permission
210 ! in whole or in part. Copies must include the above
220 ! copyright and warranty notice.
230 !
240 ! REQUIRED EQUIPMENT:
250 ! SG 5010 Programmable 160 kHz Oscillator
260 ! 4052A Controller w/ 4052R14 GPIB Enhancement Rompack, Opt 1A
270 !
280 ! PURPOSE:
290 ! Lockout SG 5010 front panel and then generate: 1) sine wave
300 ! burst 2) frequency sweep, and 3) amplitude sweep. The
310 ! program waits after 1 and 2 for a user interrupt (ID button
320 ! press). SG 5010 front panel control is restored after 3.
330 !
340 ! OPERATING PROCEDURE:
350 ! Connect the TM 5000 mainframe to 4052A GPIB port. Set
360 ! the SG 5010 address to 25 (factory default). Enter the
370 ! program and run it. To verify operation, monitor the SG
380 ! 5010 output with an oscilloscope. Set vertical at 1 V/div,
390 ! horizontal at 20 ms/div, and trisseries to normal a little
400 ! above center screen. Trisser adjustment or automatic
410 ! trisseries may be required to view amplitude sweep.
420 !
430 ! PROGRAM VARIABLES AND LABELS:
440 !
450 ! Ss_pa -- Primary address of SG 5010.
460 !
470 ! _poll_stat -- Status returned by serial poll of GPIB.
480 !
490 ! Addr_list_indx -- Index to Addr_list set by serial poll.
500 !
510 ! Addr_list -- List of addresses found by CALL "confis".
520 !
530 ! Stat_report# -- Id and event message reported by SG 5010.
540 !
550 ! Conf_code -- Required by CALL "Confis", not used by program.
560 ! ::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
570 INIT
580 PRINT "SG 5010 COMMAND PROGRAM"
590 !
600 DIM Addr_list(15)
610 Ss_pa=25
620 CALL "confis",Conf_code,Addr_list
630 IF Conf_code THEN
640 PRINT "Check for instruments connected and power on, then reRUN."
650 STOP
660 END IF
670 ON SRQ THEN 1010
680 !
690 CALL "f1o"
700 PRINT "SG 5010 front panel locked out."
710 !
720 PRINT "Press SG 5010 ID key to step through three setups."

```

```
730 I=0
740 DO
750   I=I+1
760   GOSUB I OF 840,880,920
770   EXIT IF I>2
780   WAIT
790   IF NOT(_poll_stat=67 AND Addr_list(Addr_list_indx)=Ss_pa) THEN
780
800 LOOP
810 END
820 !
830 ! Set up IHF202-like test burst
840 PRINT @Ss_pa:"INIT;FREQ 1.0E+3;FUNC BURST:10;USER ON;VRMS 2"
850 PRINT @Ss_pa:"ONCYCL 20;OFFCYCL 480;OUT ON"
860 RETURN
870 ! Set up 10s frequency sweep from 10 Hz to 100 kHz
880 PRINT @Ss_pa:"FUNC SINE;MODE FREQ;STARTFREQ 10;STOPFREQ 100.E+3"
890 PRINT @Ss_pa:"NSTEPS 40;LOG;STEPTIME .2;SWEEP REPEAT"
900 RETURN
910 ! Set up voltage sweep from 20 mV to 2 volts
920 PRINT @Ss_pa:"SWEEP OFF;FREQ 1.E+3;MODE AMP;STARTVOLTS .02"
930 PRINT @Ss_pa:"STOPVOLTS 2;NSTEPS 20;LOG;STEPTIME .1;SWEEP REPEAT"
940 RETURN
950 !
960 CALL "locs" ! Unlock instrument front panels.
970 PRINT "Front panel control restored."
980 PRINT "End of program."
990 END
1000 ! Poll the bus for service request
1010 POLL Addr_list_indx,_poll_stat;Addr_list
1020 CALL "varlst",_poll_stat,239,_poll_stat ! Mask busy bit
1030 IF Addr_list(Addr_list_indx)=Ss_pa THEN
1040   PRINT @Ss_pa:"ID?;ERRMSG?"
1050   INPUT @Ss_pa:Stat_report$
1060   PRINT Stat_report$
1070 END IF
1080 PRINT "ADDRESS=";Addr_list(Addr_list_indx),"STATUS=";_poll_stat
1090 RETURN
```

SG 5010 Instrument Interfacing Guide

4041:

```
100 ! ::::::::::::::::::::::::::::::::::::::::::::::::::::
110 ! ::::::::::::::: SG 5010 / 4041 COMMAND PROGRAM :::::::::::::::
120 ! ::::::::::::::::::::::::::::::::::::::::::::::::::::
130 !
140 ! July 11, 1983
150 !
160 ! Copyright (c) 1983, Tektronix, Inc. All rights reserved.
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180 ! warranty of any kind. It is not supported.
190 !
200 ! This software may be reproduced without prior permission
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220 ! copyright and warranty notice.
230 !
240 ! REQUIRED EQUIPMENT:
250 ! SG 5010 Programmable 160 kHz Oscillator
260 ! 4041 Controller (V2.0)
270 !
280 ! PURPOSE:
290 ! Program the SG 5010 to lockout the front panel and: 1) Generate
300 ! a sine wave burst, 2) frequency sweep, and 3) amplitude sweep.
310 ! The program waits after 1 and 2 for a user interrupt (ID button
320 ! press). SG 5010 front panel control is restored after 3.
330 !
340 ! OPERATING PROCEDURE:
350 ! Connect the TM 5000 mainframe to 4041 GPIB port 0.
360 ! Set the SG 5010 address to 25 (factory default).
370 ! Enter the program and run it. To verify operation, monitor
380 ! the SG 5010 output with an oscilloscope. Set vertical at 1 V/div,
390 ! horizontal at 20 ms/div, and trisseries to normal a little
400 ! above center screen. Trisser level adjustment or automatic
410 ! trisser may be required to view amplitude sweep.
420 !
430 ! PROGRAM VARIABLES and LABELS:
440 !
450 ! Ss_lu -- Logical unit number of SG 5010.
460 !
470 ! I -- Counter for waveform types (see comments under PURPOSE).
480 !
490 ! Poll_sta -- Status returned by serial poll on the GPIB.
500 !
510 ! Poll_add -- Address of instrument reporting poll_sta.
520 !
530 ! Sta_ret$ -- Id and event code reported by SG 5010.
540 !
550 ! Address -- Line where SG 5010 logical unit variable is assigned.
560 ! Burst -- Beginning line for block that generates a signal burst.
570 ! Freq_swp " " " " " " " frequency sweep.
580 ! Amp_swp " " " " " " " an amplitude sweep.
590 ! Poll_bus " " " " " " handles serial poll.
600 !
610 ! Finish -- Where program goes to end.
620 ! ::::::::::::::::::::::::::::::::::::::::::::::::::::
630 ! Init var all
640 ! Print "SG 5010 IIG COMMAND PROGRAM"
650 ! Dim sta_ret$ to 80
660 ! Integer ss_lu,poll_sta,poll_add,i
670 Address: ss_lu=25 ! Default lu equal to GPIB primary address
680 On sra then gosub poll_bus
690 Enable sra
700 !
710 !%byte llo ! Lockout front panel of instruments on bus.
720 ! Print "Front panel locked out."
```



```
730 !
740 Print "Press SG 5010 ID key to step through three setups."
750 For i=1 to 3
760   Gosub i of burst, fra_swp, amp_swp
770   If i>2 then exit to finish
780   Wait
790   If poll_sta(>67 or poll_add(>ss_lu then goto 780 ! Check for ID key press
800   Next i
810 !
820 ! Set up IHF A202-like test burst
830 Burst:   print #ss_lu:"INIT;FREQ 1.0E+3;FUNC BURST;10;USER ON;VRMS 2"
840   print #ss_lu:"ONCYCL 20;OFFCYCL 480;OUT ON"
850   Return
860 Fra_swp:  print #ss_lu:"FUNC SINE;MODE FREQ;STARTFREQ 10;STOPFREQ 100.E+3"
870   print #ss_lu:"NSTEPS 40;LOG;STEPTIME .1;SWEEP REPEAT"
880   Return
890 Amp_swp:  print #ss_lu:"SWEEP OFF;FREQ 1.E+3;MODE AMP;STARTVOLTS .02"
900   print #ss_lu:"STOPVOLTS 2;NSTEPS 20;LOG;STEPTIME .1;SWEEP REPEAT"
910   Return
920 !
930 Poll_bus: poll poll_sta,poll_add
940   poll_sta=poll_sta band [11101111b] ! Mask busy bit
950   If poll_add(>ss_lu then goto 980
960   Input #ss_lu prompt "id?ierrms?":sta_rpt$
970   Print sta_rpt$
980   Print "ADDRESS=";poll_add;"STATUS=";poll_sta
990   Resume
1000 !
1010 Finish:  wbyte ren(0),ren(1) ! Unlock instrument front panels
1020   Print "Front panel control restored."
1030   Print "End of program."
1040   End
```

ASCII & GPIB CODE CHART

BITS		B7	B6	B5	B4	B3	B2	B1	CONTROL		NUMBERS SYMBOLS		UPPER CASE		LOWER CASE		
		0	1	0	1	0	1	0	1								
0	0	0	0	0	0	0	0	0	0	NUL	DLE	SP	0	@	P	'	p
0	1	0	1	0	0	0	0	0	1	GTL	LLO	!	1	A	Q	a	q
1	0	1	0	1	0	0	0	0	1	SOH	DC1	!	1	A	Q	a	q
1	1	1	0	1	0	0	0	0	1	STX	DC2	"	2	B	R	b	r
1	1	1	1	1	0	0	0	0	1	ETX	DC3	#	3	C	S	c	s
1	1	1	1	1	1	0	0	0	1	EOT	DC4	\$	4	D	T	d	t
1	1	1	1	1	1	1	0	0	1	ENQ	NAK	%	5	E	U	e	u
1	1	1	1	1	1	1	1	0	1	ACK	SYN	&	6	F	V	f	v
1	1	1	1	1	1	1	1	1	1	BEL	ETB	'	7	G	W	g	w
1	1	1	1	1	1	1	1	1	1	BS	CAN	(	8	H	X	h	x
1	1	1	1	1	1	1	1	1	1	HT	EM	)	9	I	Y	i	y
1	1	1	1	1	1	1	1	1	1	LF	SUB	*	:	J	Z	j	z
1	1	1	1	1	1	1	1	1	1	VT	ESC	+	;	K	[	k	{
1	1	1	1	1	1	1	1	1	1	FF	FS	,	<	L	\	l	|*
1	1	1	1	1	1	1	1	1	1	CR	GS	-	=	M	]	m	}
1	1	1	1	1	1	1	1	1	1	SO	RS	.	>	N	^	n	~
1	1	1	1	1	1	1	1	1	1	SI	US	/	?	O	_	o	DEL (RUBOUT)

KEY

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



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

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Utility Software for TM5000 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.

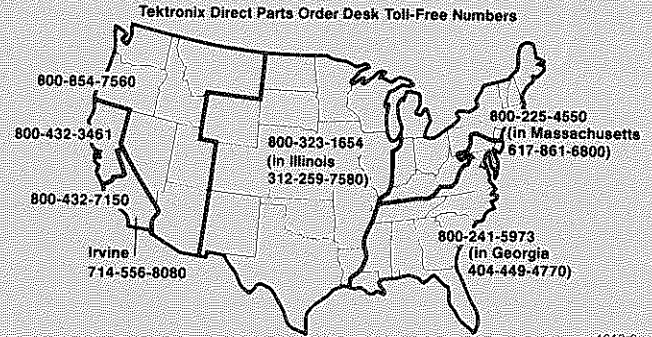
Description	Tektronix Part No.
TM 5000/4041 Utility Software (DC-100 tape)	062-6958-01
TM 5000/4052A Utility Software (DC-300 tape)	062-6957-01

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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

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

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.

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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:

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