Operating Manual

H 6310
Vol. 1A
PROVISIONAL

2 TO 20 GHZ PROGRAMMABLE SWEEP GENERATOR

6310

- GPIB OPERATION -

(IEE 488-1978: SH1,AH1,T6,L4,SR1,RL1,PP0,DC1,DT0,E2)

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Chapter 1

GENERAL INFORMATION

CONTENTS

ABOUT THIS MANUAL

1. This manual is divided into chapters and a number of appendices. This chapter gives general information about the remote operation of the sweeper using the General Purpose Interface Bus (GPIB). Chapter 2 gives specific information on the various programming modes available with the sweeper including general syntax guidelines.

   The appendices form a collection of useful information on all aspects of GPIB control.

2. Although this manual is self contained and gives all the information necessary to operate the sweeper using GPIB, familiarity with local operation is assumed. Local operation is described in the sweeper Operating Manual Vol.1.

INTRODUCTION

3. The implementation of GPIB remote operation on the sweeper conforms to the IEEE 488-1978 (IEC 625-1) and IEEE 728-1982 (IEC 625-2) standards. Appendix A gives detailed information on the interface capabilities as defined in IEEE 488-1978. Information on IEEE 728-1982 data formats used in the sweeper is given where appropriate. Access to these IEEE standards is not essential for remote operation of the sweeper as all relevant information is given in this manual.

!! CAUTION !!

4. On the sweeper rear panel there are two GPIB connectors. One is labelled SYSTEM and the other is labelled PRIVATE. The sweeper is able to control various devices using the PRIVATE bus, details of which are given in Vol.1 of the operating manual. Under no circumstances should a GPIB controller be connected to the PRIVATE bus connector as a hardware conflict could arise, possibly resulting in damage to one or both interfaces. The information in this manual relates, in general, only to operation using the SYSTEM bus. The section in Chapter 2 headed COMMUNICATION WITH THE PRIVATE BUS gives information on the relationship between the two bus systems and the facilities available for communication between them.

SETTING THE GPIB ADDRESSES

5. The sweeper has two GPIB addresses. One is for normal control of the sweeper using the SYSTEM bus and the other is for communicating with devices connected to the PRIVATE bus. The sweeper is supplied with default GPIB addresses of 19 for the SYSTEM bus and 18 for PRIVATE bus pass-through. These values may be changed from the sweeper front panel using the following procedure:

First, select STATUS 2 display by pressing [SHIFT] followed by [8]. The LCD should now appear like this:

```
S_ADDR 19                  CONTRST 10
P_ADDR 18                  OP_HRS    45
[]
→L R       S_ADDR  P_ADDR            CONTRST
```

Select the address you wish to change using the [S_ADDR] or [P_ADDR] soft keys. When selected, the soft key label will flash and the numeric entry field [] will be enabled. Enter the required address using the numeric keys and terminate your entry with the [int] key. The valid address range is 0 to 30. Note that the sweeper will not allow S_ADDR and P_ADDR to be set to the same value. Normal operation can be resumed by pressing one of the other configuration keys.

SWEEPER FIRMWARE DESIGN PHILOSOPHY

6. An awareness of the fundamental aspects of the sweeper operation is a useful aid to gaining a good understanding of the various GPIB programming facilities available. The operation of the sweeper is governed by a set of parameters controlled by the instrument's firmware. Each one of these parameters contains the current value of one of the sweeper operating functions. There is, for example, a parameter containing the start frequency, one for stop frequency, another for sweep time, power level, etc. All hardware interfacing is performed by manipulation of these parameters and extensive consistency checking is performed on all parameter update operations. This philosophy has resulted in a consistent and reliable firmware implementation. Familiarity with this design concept is not necessary for local operation, but will be useful to the GPIB programmer since many of the GPIB commands allow direct manipulation of the parameters.

7. Operation of the sweeper from the front panel, or by GPIB, causes changes to the parameter values and, subject to satisfactory consistency checking, consequential changes to the instrument hardware.

8. GPIB operation can be broadly divided into four areas:

   (i) Normal control of parameters. GPIB commands in this group generally reflect front panel operation and are the most commonly used in normal applications.

   (ii) Binary control of parameters. Parameter data can be transferred to and from the sweeper in a compact binary format, allowing maximum speed of operation.

   (iii) Key press imitation. Separate GPIB commands are provided for each front panel key. These are processed in exactly the same manner as actual key presses and allow complete imitation of front panel operation.

   (iv) Binary data transfer. Several commands are provided for transferring binary data to and from the sweeper. Examples of this are LCD text, user defined characters, calibration data and instrument settings. These commands allow fast transfer of relatively large amounts of data.

   Each of these areas of operation is considered in greater detail in Chapter 2 together with other topics such as SRQ operation and communication with the private bus system.

GPIB INTERFACE STATUS INDICATION

9. In most operating modes the current state of the GPIB interface is indicated by the second character of the status field displayed in the bottom left corner of the LCD. The interface can be in one of 6 states:

LL	Local listen state
LT	Local talk state
L	Local unaddressed state
RL	Remote listen state
RT	Remote talk state
R	Remote unaddressed state

The actual form of the character used to indicate these states is illustrated in Appendix B (character 1E).

Chapter 2

OPERATION

CONTENTS

Para.

GENERAL GPIB COMMAND STRUCTURE

1. This chapter is intended to be a reasonably informal guide to remote operation of the sweeper. Where examples or tables are given the following conventions apply:

< >	Encloses an element of the command or language which is described elsewhere in the text (i.e. it is not literal).
[ ]	Encloses an item which is (or may be) optional.
< > ... < >	Indicates that the element may be repeated.
< >/< >	Indicates a choice of elements.

Generally, items not enclosed by < > are literals and should be used exactly as shown.

Programming examples are given for Hewlett Packard Series 200 controllers but the principles used apply to all controllers. The examples assume that an IO path called @Sweeper has been declared. On a Series 200 controller this would typically be achieved as follows:

ASSIGN @Sweeper TO 719

All GPIB commands implemented on the sweeper can be broken down into four parts as follows:

(i) The MNEMONIC or INSTRUCTION part. This usually consists of a two or four character mnemonic which may sometimes be preceded by OP when it is desired to read the current value of a parameter. The sweeper mnemonics have been designed to convey the meaning of the operation as far as possible. In general, the first two characters of a four character mnemonic indicate a functional group of commands. For example, all instructions which deal with markers have four character mnemonics of which the first two characters are always MK. Many sweeper mnemonics are compatible with other GPIB controlled sweep oscillators such as the HP8350.

(ii) The PARAMETER or VALUE part. This will usually consist of a numeric value which quantifies the instruction part. Some instructions are simply 'action' commands and do not require numeric quantifiers. For these commands the VALUE part is omitted. The formats used for numeric entry depend on the instruction, but in general these will comply with the formats defined in IEEE 728-1982.

(iii) The TERMINATOR part. This is only required for instructions whose parameter part can be given in more than one type of units. It consists of a two character mnemonic indicating the units used. For example, frequency values may be entered in GHz, MHz, KHz or Hz. Four coresponding terminator mnemonics, GZ, MZ, KZ and HZ, are provided for this purpose.

(iv) The SEPARATOR part. All the sweeper GPIB commands must include a valid separator. Three types of separator are used and are defined in IEEE 728-1982. In some cases, the type of separator used is optional, whilst in others, block transfers for example, a particular separator must be used.

2. This is an example of a typical sweeper GPIB command containing the four parts outlined above:

FA14.627GZ<crlf>

This is a typical GPIB controller BASIC statement to output the above command:

OUTPUT @Sweeper;"FA14.627GZ"

In this particular case the separator used is <crlf> which is normally sent by the controller automatically at the end of the OUTPUT statement. This conforms to the SR2 separator definitiion in IEEE 728-1982 which allows <crlf> or just <lf>. The SR1 separator definition allows <,> or <;> to be used, giving the opportunity to send more than one sweeper command in a single statement like this:

OUTPUT @Sweeper;"FA14.627GZ,FB19.385GZ"

3. The SR1 and SR2 separators are the most commonly used in normal applications, although the SR3 separator is usually allowed also. The SR3 separator is the special EOI bus signal asserted concurrently with the last data byte of a transaction and is normally used with binary transfer operations which are dealt with in later sections.

4. Note that any mixture of upper and lower case characters may be used for sweeper GPIB mnemonics.

NORMAL CONTROL OF INSTRUMENT PARAMETERS

5. The table on the following pages gives details of all sweeper GPIB commands which allow control of the instrument parameters mentioned in Chapter 1. There are additional commands which relate to specific aspects of sweeper operation, such as private bus communication and calibration data transfer, and these are discussed and tabulated in later sections. The table gives the following information for each command:

   (i) The mnemonic. This may be prefixed with [OP] indicating that the command has READ/WRITE status. More information on reading parameter values is given in the next section. Some commands have READ ONLY status and are always prefixed by OP.

   (ii) The allowable range of values (if any).

   (iii) The allowable terminators (if any).

   (iv) A brief desciption of the purpose of the command.

6. The commands are divided into functional groups. Information on the standard output format and units is given for each functional group.

7. The general command format is:

   <mnemonic>[<value>][<terminator>]<SR1>/<SR2>/<SR3>

8. The table is reproduced for reference in Appendix E.

TABLE 1 - GPIB COMMANDS FOR PARAMETER CONTROL

FREQUENCY PARAMETERS - Output format: DDD.DDDDDD (GHz)

MNEMONIC	VALUE RANGE	TERMINATORS	DESCRIPTION
[OP] FA	1.9/20.1GHz	GZ/MZ/KZ/HZ	[Output] Start frequency.
[OP] FB	1.9/20.1GHz	GZ/MZ/KZ/HZ	[Output] Stop frequency.
[OP] CF	1.9/20.1GHz	GZ/MZ/KZ/HZ	[Output] Centre frequency in sweep mode, or CW frequency in CW mode.
[OP] DF	0/18.2GHz	GZ/MZ/KZ/HZ	[Output] Delta frequency symmetrical about centre frequency.
[OP] MKFA	1.9/20.1GHz	GZ/MZ/KZ/HZ	[Output] Marker A frequency.
[OP] MKFB	1.9/20.1GHz	GZ/MZ/KZ/HZ	[Output] Marker B frequency.
[OP] MKFC	1.9/20.1GHz	GZ/MZ/KZ/HZ	[Output] Marker C frequency.
[OP] MKFD	1.9/20.1GHz	GZ/MZ/KZ/HZ	[Output] Marker D frequency.
[OP] MKFE	1.9/20.1GHz	GZ/MZ/KZ/HZ	[Output] Marker E frequency.
[OP] MKFR	1.9/20.1GHz	GZ/MZ/KZ/HZ	[Output] Reference marker frequency.
OPMKDF			Output marker delta frequency.
[OP] FD	0/10GHz	GZ/MZ/KZ/HZ	[Output] Frequency increment.
[OP] MF	1/100kHz	GZ/MZ/KZ/HZ	[Output] Amplitude modulation frequency.

Note: Output format for OPMF is DDD.DDD (kHz).

TABLE 1 - GPIB COMMANDS FOR PARAMETER CONTROL - continued

POWER PARAMETERS - Output format: SDD.DDD (dB)

MNEMONIC	VALUE RANGE	TERMINATORS	DESCRIPTION
[OP] PL	-15/20dBm 0.031622/100	DB MW	[Output] Power level.
[OP] PA	-15/20dBm 0.031622/100	DB MW	[Output] Start power level. Same parameter as [OP] PL.
[OP] PB	-15/20dBm 0.031622/100	DB MW	[Output] Stop power level.
[OP] PD	0/5dB 0.1/20mW	DB MW	[Output] Power increment.
[OP] SL	0/20dB	DB	[Output] Power slope (dB/GHz).

Note: Output of power parameters is in dB(m) ONLY.

TIME PARAMETERS - Output format: DDDDD.D (ms)

MNEMONIC	VALUE RANGE	TERMINATORS	DESCRIPTION
[OP] ST	10ms/33.5s	SC/MS	[Output] Sweep time.
[OP] Sl			Same as [OP] ST.
[OP] TD	1ms/10s	SC/MS	[Output] Sweep time increment.

TABLE 1 - GPIB COMMANDS FOR PARAMETER CONTROL - continued

MARKER CONTROL PARAMETERS - Output format: NR1

MNEMONIC	VALUE RANGE	TERMINATORS	DESCRIPTION
[OP] MKRS	0/4		[Output] Select[ed] reference marker A/E.
[OP] MKSS	0/4		[Output] Select[ed] stop marker A/E.
[OP] MKMA	0/31		[Output] Marker mask.
[OP] MKRE	0/1		[Output] Reference marker disabled/enabled.
MKAE	0/1		All markers disabled/enabled.
MKCF			Assign reference marker frequency to centre frequency.
[OP] MKSW	0/1		Marker sweep off/on (reference -> stop).
MKTR			Transfer values of reference and stop markers to start and stop frequencies (make marker sweep permanent).

TABLE 1 - GPIB COMMANDS FOR PARAMETER CONTROL - continued

OPERATING MODE PARAMETERS - Output format: NR1

MNEMONIC	VALUE RANGE	TERMINATORS	DESCRIPTION
[OP] MO	0/3		[Output] Operating mode. 0: CW 1: Power sweep 2: F1-F2 3: Power slope
[OP] VN	0/1		[Output] Vernier off/on (CW only).
[OP] SW	0/1		[Output] Sweep mode. 0: Internal 1: External
[OP] TR	0/3		[Output] Sweep trigger mode. 0: Internal 1: External 2: Line 3: Single
SS			Trigger single sweep.
OPSS	0/2		Output single sweep status. 0: Ready 1: Sweeping 2: Inactive
[OP] LC	0/3		[Output] Levelling control mode 0: Internal 1: External (+ve) 2: External (-ve) 3: Power meter.
OPLV	0/1		Output levelled off/on.
[OP] RF	0/1		[Output] RF off/on.
[OP] MD	0/1		[Output] Amplitude modulation off/on.
[OP] BL	0/1		[Output] RF blanking off/on.
[OP] FL	0/1		[Output] CW filter off/on.
[OP] CT	0/3		[Output] Counter trigger point. 0: Off 1: F1 2: F2 3: Reference marker
[OP] AM	0/2		[Output] Alternate sweep mode. 0: Off 1: Manual 2: Auto
[OP] AS	0/1		Alternate sweep manual select. 0: Current settings 1: Memory settings

TABLE 1 - GPIB COMMANDS FOR PARAMETER CONTROL - continued

MISCELLANEOUS PARAMETERS - Output format: NR1

MNEMONIC	VALUE RANGE	TERMINATORS	DESCRIPTION
[OP] CH	0/23		[Output] Clock hours.
[OP] CM	0/59		[Output] Clock minutes.
[OP] CS	0/59		[Output] Clock seconds.
OPTT			Output total 'power on' time.
[OP] UT	0/99999		[Output] User time.
[OP] VA	1/20		[Output] LCD viewing angle (contrast).
MEMS	1/20		Store instrument settings.
MEMR	1/21		Recall instrument settings. 21 recalls preset settings.
[OP] MEMA	0/20		[Output] Memory used for alternate sweep. 0 specifies current settings.
OPLK			Output code of last key pressed. See diagram in Appendix D for key codes.
OPER			Output code of last error. See Appendix H for error codes.
OPIS			Output firmware issue status.
OPSN			Output instrument serial number.
[OP] ID	1/65535		[Output] Integer increment.

TABLE 1 - GPIB COMMANDS FOR PARAMETER CONTROL - continued

DIAGNOSTIC PARAMETERS - Output format: NR1

MNEMONIC	VALUE RANGE	TERMINATORS	DESCRIPTION
[OP] DCRM	0/4095		[Output] Ramp DAC value.
[OP] DCOS	0/65535		[Output] Offset DAC value.
[OP] DCLL	0/65535		[Output] Level DAC value.
[OP] DCSC	0/65535		[Output] Scale DAC value.
[OP] DCVN	0/4095		[Output] Vernier DAC value.
[OP] DCBA	0/2		[Output] Band switch value.
[OP] DCCA	0/255		[Output] PPI(A) value.
[OP] DCCB	0/255		[Output] PPI(B) value.
[OP] DCCC	0/65535		[Output] Control RAM value.
[OP] DCPG	0/15		[Output] Programmable latch value.

Note: The diagnostic parameters are included here for completeness but are not designed for use in normal applications. Further information on these commands is not given in this manual.

READING PARAMETER VALUES

9. The previous section indicated that it is possible to read the current value of most parameters from the sweeper. Parameter contents are output by the sweeper as numeric values in an ASCII representation.

10. Included with each functional group heading in Table 1 is a definition of the numeric output format. In some cases this is defined explicitly and in others reference is made to a numeric format defined in IEEE 728-1982. In the explicit definitions S means a sign (+ or -) and D means a digit. Thus an example of SDD.DDD would be -04.365. References to NR1 usually mean that a free-field integer value is output. The output format definitions also indicate the output units where appropriate.

11. Parameters whose contents may be read from the sweeper have entries in Table 1 preceeded by [OP] or have OP as the first two characters of the mnemonic. The latter type are termed 'READ ONLY' parameters which means that you may read the contents but you cannot change them. An example of a read only parameter is TOTAL TIME (OPTT).

12. Parameters which do not fall into either of the two categories described above are WRITE ONLY parameters whose contents cannot be read over the bus. An example of a write only parameter is MKCF. Most of the write only parameters are 'action' parameters which have no associated value.

13. Reading the contents of a parameter involves two steps:

(i) First the appropriate command is sent to the sweeper. For a typical controller this would be achieved with an OUTPUT statement like this:

OUTPUT @Sweeper;"OPFA"

This would instruct the sweeper to output the current start frequency value.

(ii) When the sweeper is next addressed to talk the value will be output. Normally the value would be received into a numeric variable by the controller with, typically, an ENTER statement such as this:

ENTER @Sweeper;F

The command syntax will obviously depend on the controller in use but the principle will be the same.

BINARY CONTROL OF PARAMETERS

14. The GPIB commands discussed so far allow control of the instrument parameters using ASCII command mnemonics and parameter representations. The sweeper decodes the mnemonics and converts the ASCII representation of parameter values into a binary format for internal storage. This method ensures that control programs are reasonably easy to read and understand.

15. In some applications it may be desirable to achieve maximum speed of operation and minimum code size at the expense of readability. To accommodate this the sweeper allows communication with most of the parameters in their internal binary format. This eliminates the decoding and conversion processes and allows many operations to be accomplished in a single command. Only parameters which can be read from and written to are made available for binary control. This gives the additional advantage that any combination of binary parameter values read from the sweeper may be re-written without modification. This feature allows selective storage and retrieval of instrument settings, thus supplementing the instrument settings transfer facility discussed later.

16. Each parameter is assigned a 'logical parameter number'. The data sent to and received from the sweeper for each parameter consists of two items, the logical parameter number and the parameter value. The logical parameter number is represented by a single byte and the parameter value by a four-byte 32 bit binary number. These data pairs may be concatenated to form a string of bytes representing several parameters. In order to conform to the binary data formats recommended in IEEE 728-1982 the binary parameter string is prefixed by the preamble #I.

The binary parameter string format may be represented as:

#I<lpn><pv><<lpn><pv>> ... <<lpn><pv>>

where #I is the preamble.
<lpn> is a 1 byte logical parameter number.
<pv> is a 4 byte parameter value.

17. Two mnemonics are provided to allow writing and reading of binary parameter strings. To write a binary parameter string to the sweeper the WB command is used as follows:

WB<binary parameter string><SR3>

18. Note that since the normal terminating characters <cr> or <lf> may be present in the binary parameter string only the SR3 separator is allowed. The EOI signal must be asserted by the controller concurrently with transmission of the final data byte. On a Series 200 controller, for example, this could be accomplished by:

OUTPUT @Sweeper USING "#,K";"WB"&Bps$ END

where Bps$ is a string variable containing the binary parameter string. In this example END is part of the controller command syntax which causes the EOI separator to be used and the # image specifier suppresses the normal <crlf> end of line sequence.

Consult your controller manuals for information on the EOI separator and how to use it.

19. The RB command is used to tell the sweeper to output binary parameter data when next addressed to talk. This command is actually a binary transfer itself, consisting of a sequence of bytes which represent the logical parameter numbers of the parameters whose contents are to output. The format for the parameter number sequence is:

#I<lpn><lpn> ... <lpn>

where #I is the preamble.
<lpn> is a 1 byte logical parameter number.

20. Suppose we wanted the sweeper to output the binary values of parameters 12 and 36. On a Series 200 controller we would send the following command:

OUTPUT @Sweeper USING "#,K";"RB#I"&CHR$(12)&CHR$(36) END

21. As in our previous WB example the image specifier and the END statement ensure that the EOI separator is used to terminate the transfer. We can now enter the binary information from the sweeper into a string variable as follows:

ENTER @Sweeper USING "%,-K";Binary_data$

22. The format used by the sweeper for the output of binary data is identical to that used by the WB command. Thus following the above sequence Binary_data$ would contain:

#I<lpn><pv><lpn><pv>

where the first <lpn> is a single byte representing the number 12, the first <pv> is the 4 byte binary representation of the contents of parameter 12, and the second pair of data items describe parameter 36 in a similar way. A particular advantage of using identical data formats is that parameter data can be read from the sweeper, stored, and then passed back again without modification. However, if data manipulation is required, it is a relatively simple task to extract the numeric parameter values from the binary data string.

23. Table 2 lists the parameters which can be accessed by binary control in the same order as Table 1. Table 2 is also reproduced in Appendix F for reference. The following items of information are given:

Normal control mnemonic - for cross-reference to Table 1.

Brief description of parameter.

Logical parameter number.

Value of 1 LSB (least significant bit) where appropriate.

Minimum value/Maximum value.

For functional descriptions of parameters refer to Table 1.

TABLE 2 - BINARY PARAMETER CONTROL

FREQUENCY PARAMETERS

MNEMONIC	DESCRIPTION	LPN	LSB	RANGE
[OP] FA	Start frequency	1	1kHz	1900000/20100000
[OP] FB	Stop frequency	2	1kHz	1900000/20100000
[OP] CF	Centre/CW frequency	3	1kHz	1900000/20100000
[OP] DF	Delta frequency	4	1kHz	0/18200000
[OP] MKFA	Marker A frequency	5	1kHz	1900000/20100000
[OP] MKFB	Marker B frequency	6	1kHz	1900000/20100000
[OP] MKFC	Marker C frequency	7	1kHz	1900000/20100000
[OP] MKFD	Marker D frequency	8	1kHz	1900000/20100000
[OP] MKFE	Marker E frequency	9	1kHz	1900000/20100000
[OP] MKFR	Ref. marker frequency	10	1kHz	1900000/20100000
[OP] FD	Frequency increment	12	1kHz	0/10000000
[OP] MF	Modulation frequency	13	1Hz	1000/100000

TABLE 2 - BINARY PARAMETER CONTROL - continued

POWER PARAMETERS

MNEMONIC	DESCRIPTION	LPN	LSB	RANGE
[OP] PL	Power level	14	.001dBm	-15000/20000
[OP] PA	Same as [OP] PL			
[OP] PB	Stop power level	15	.001dBm	-15000/20000
[OP] PD	Power increment	16	.001dB	0/5000
[OP] SL	Power slope	17	.001dB	0/20000

Note: Binary control of power parameters is available only in dB(m).

TIME PARAMETERS

MNEMONIC	DESCRIPTION	LPN	LSB	RANGE
[OP] ST	Sweep time	21	.1ms	100/335000
[OP] S1	Same as [OP] ST			
[OP] SD	Sweep time increment	22	.1ms	10/100000

TABLE 2 - BINARY PARAMETER CONTROL - continued

MARKER CONTROL PARAMETERS

MNEMONIC	DESCRIPTION	LPN	LSB	RANGE
[OP] MKRS	Select ref. marker	70		0/4
[OP] MKSS	Select stop marker	71		0/4
[OP] MKMA	Marker mask	37		0/31
[OP] MKRE	Enable ref. marker	60		0/1
[OP] MKSW	Marker sweep off/on	65		0/1

OPERATING MODE PARAMETERS

MNEMONIC	DESCRIPTION	LPN	LSB	RANGE
[OP] MO	Operating mode	59		0/3
[OP] VN	Vernier off/on	69		0/1
[OP] SW	Sweep mode int/ext	52		0/1
[OP] TR	Trigger mode	50		0/3
[OP] LC	Levelling control mode	51		0/3
[OP] RF	RF off/on	53		0/1
[OP] MD	Amplitude mod off/on	54		0/1
[OP] BL	RF blanking off/on	55		0/1
[OP] FL	CW filter off/on	49		0/1
[OP] CT	Counter trigger point	48		0/3
[OP] AM	Alternate sweep mode	67		0/2
[OP] AS	Alt. sweep manual select	68		0/1

TABLE 2 - BINARY PARAMETER CONTROL - continued

MISCELLANEOUS PARAMETERS

MNEMONIC	DESCRIPTION	LPN	LSB	RANGE
[OP] CH	Clock hours	23	1hr	0/23
[OP] CM	Clock minutes	24	1min	0/59
[OP] CS	Clock seconds	25	1sec	0/59
[OP] UT	User time	27	1hr	0/99999
[OP] VA	Viewing angle (contrast)	28		1/20
[OP] MEMA	Alt. sweep memory	34		0/20
[OP] ID	Integer increment	29		1/65535

TABLE 2 - BINARY PARAMETER CONTROL - continued

DIAGNOSTIC PARAMETERS

MNEMONIC	DESCRIPTION	LPN	LSB	RANGE
[OP] DCRM	Ramp DAC	38		0/4095
[OP] DCOS	Offset DAC	39		0/65535
[OP] DCLL	Level DAC	40		0/65535
[OP] DCSC	Scale DAC	41		0/65535
[OP] DCVN	Vernier DAC	42		0/4095
[OP] DCBA	Band switch	43		0/2
[OP] DCCA	PPI(A)	45		0/255
[OP] DCCB	PPI(B)	46		0/255
[OP] DCCC	Control RAM	44		0/65535
[OP] DCPG	Programmable latch	47		0/15

PRIVATE GPIB PARAMETERS

Note: Communication with the private GPIB system is discussed in detail in a later section of this chapter. The normal control mnemonics in this section appear in Table 10, not Table 1.

MNEMONIC	DESCRIPTION	LPN	LSB	RANGE
[OP] PR	Private bus address	31		0/30

KEY PRESS IMITATION

24. In addition to normal and binary parameter control it is possible to imitate front panel operation using a special set of GPIB commands. This mode of operation was originally devised for demonstration and tutorial purposes but may prove useful for simple tasks where the programmer is more familiar with local operation. There is a separate command for each front panel key, excluding LOCAL, and each direction of the rotary control. Each command has a two character mnemonic with the first character always being 'K'. Sequences of keypress mnemonics may be used to simulate any front panel operation. For example, to select power sweep mode using keypress imitation the following string would be sent:

KN,KJ

This coresponds to the key sequence:

[SHIFT] [CW]

Then a start power level of -5dBm could be set with:

KP,K-,K5,KM

which coresponds to the key sequence:

[SOFT KEY 2] [-] [5] [dBm]

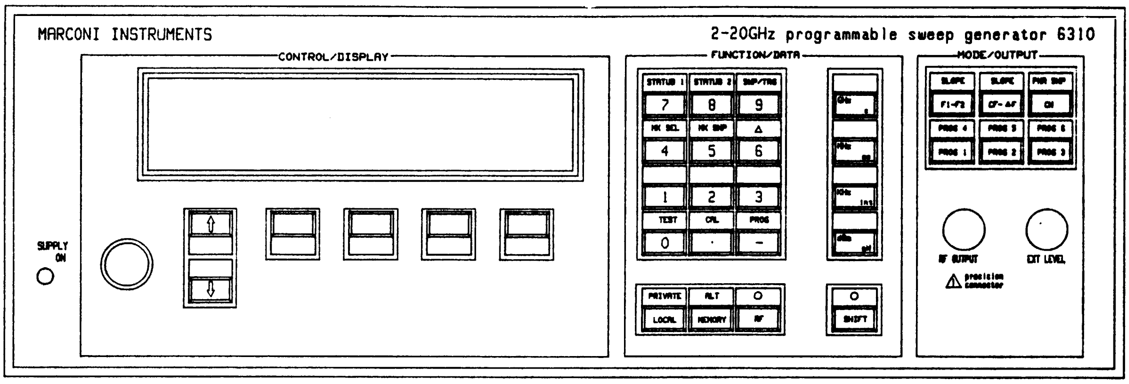
25. Keypress mnemonics invoke the firmware control routines normally used for keyboard operation. Therefore the response to a keypress mnemonic is identical to that which occurs when the actual key is pressed.

26. Table 3 lists all the keypress mnemonics and the legends of the related keys. If the key has a shifted function both legends are given. Table 3 is duplicated in appendix E for reference.

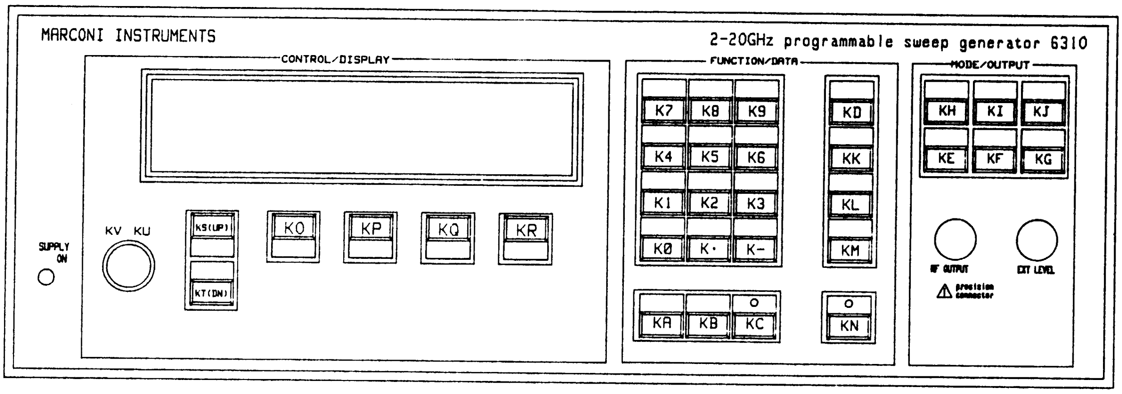
TABLE 3 - KEYPRESS MNEMONICS

UNSHIFTED FUNCTION	SHIFTED FUNCTION	MNEMONIC
STEP UP	-	KS (or UP)
STEP DOWN	-	KT (or DN)
SOFT KEY 1	-	KO
SOFT KEY 2	-	KP
SOFT KEY 3	-	KQ
SOFT KEY 4	-	KR
0	TEST	K0
1	-	K1
2	-	K2
3	-	K3
4	MK SEL	K4
5	MK SWP	K5
6	DELTA	K6
7	STATUS 1	K7
8	STATUS 2	K8
9	SWP/TRIG	K9
.	CAL	K.
-	PROG	K-
GHz / s	-	KD
MHz / ms	-	KK
KHz / int	-	KL
dBm / mW	-	KM
F1-F2	SLOPE	KH
CF-dF	SLOPE	KI
CW	PWR SWP	KJ
PROG 1	PROG 4	KE
PROG 2	PROG 5	KF
PROG 3	PROG 6	KG
LOCAL	PRIVATE	KA
MEMORY	ALT	KB
RF	-	KC
SHIFT	-	KN
ROTARY CONTROL:		
CLOCKWISE	-	KU
ANTI-CLOCKWISE	-	KV

27. This diagram shows the keypress mnemonics superimposed on the front panel.



Key designations



Equivalent keypress mnemonics

LCD TEXT TRANSFER

28. Text may be read from and written to the sweeper LCD. Reading text from the LCD is accomplished with the RT command. This command instructs the sweeper to output the entire contents of the LCD when next addressed to talk. The text is output as a block of 160 bytes prefixed with the #I preamble and terminated with the SR3 separator (EOI concurrent with the last data byte). The format looks like this:

#I<text>

29. The text could be read into a string variable which should be dimensioned to at least 162 characters. A typical Series 200 controller sequence would be:

```
DIM Text$[162]
     .
     .
OUTPUT @Sweeper;"RT"
ENTER @Sweeper USING "%,-K";Text$
```

30. The text string consists of the text from each of the four lines on the LCD in sequence. With this knowledge it is possible to extract any single character or group of characters for examination. One of the soft key fields, for example, could be examined to determine which parameter is currently assigned to that key.

31. Text is written to the LCD with the WT command which has the following format:

WT"<text>"<SR1>/<SR2>/<SR3>

<text> may consist of any normal ASCII characters, programmable characters or control characters. The sweeper maintains a text pointer and it is here that incoming text is placed. Note that when the text reaches the end of a line subsequent characters overwrite the last character cell on that line. Therefore, in order to send text which was read with the RT command <cr><lf> characters must be inserted at the end of each line.

32. The normal ASCII characters are all those from 32 (20H) up to 127 (7FH). Appendix B shows the standard LCD character set.

33. The programmable characters are assigned codes 24 (18H) to 31 (1FH). Prgrammable characters 1 and 2 (codes 24 and 25) may be defined by the user. Details of user-defined characters are given in the next section. The remaining programmable characters are defined by the sweeper operating firmware. These are used mainly for the status indicators and special characters used in the programmable key editor. Note that the form of these characters will depend on the current status and operating mode of the instrument. Appendix B shows all the pre-defined forms used. The programmable characters are allocated as follows:

Character	Dec	Hex	Function
1	24	18	User-defined
2	25	19	User-defined
3	26	1A	Not used (blank)
4	27	1B	Cal type indicator
5	28	1C	Delta character
6	29	1D	Mu character
7	30	1E	GPIB status indicator / dots
8	31	1F	Mode indicator / vertical bar

34. A number of control characters are available which manipulate the text pointer and perform various other functions. These are defined as follows:

Dec	Hex	Function
1	1	Home (text pointer set to top left of LCD)
2	2	Clear current line (text pointer set to beginning)
7	7	Move text pointer right
8	8	Move text pointer left
10	A	Move text pointer down (line feed)
11	B	Move text pointer up
12	C	Clear screen (text pointer set to top left)
13	D	Carriage return
14	E	Enable flashing characters (Note 1)
15	F	Disable flashing characters (Note 1)
16	10	Clear field (Note 1)
17	11	Set text pointer to XY coordinates (Note 2)

Notes:

1. Followed by a byte (1-160) indicating the range.
2. Followed by 2 bytes:

   i. (0-39) indicating X location
   ii. (0-3) indicating Y location

35. As an example, suppose we wished to write the message 'Marconi' at the beginning of the second line of the LCD. This would be accomplished on a Series 200 controller the following statement:

```
OUTPUT @Sweeper;"WT"&CHR$(34)&CHR$(1)&CHR$(10)&"Marconi"&CHR$(34)
```

where CHR$(34) is the quote symbol required by WT.
CHR$(1) moves the cursor to the top left of the LCD.
CHR$(10) moves the cursor down to second line.

PROGRAMMABLE CHARACTER TRANSFER

36. The sweeper LCD module has 8 programmable characters. The way in which the sweeper uses these characters is described in the previous section. Data defining the current state of all the programmable characters may be read by a controller. Two of the programmable characters may be defined by the controller by sending the appropriate data to the sweeper.

37. The RC command is used to instruct the sweeper to output programmable character data when next addressed to talk. The command is sent with no parameters:

RC<SR1>/<SR2>/<SR3>

38. The data returned has the following format:

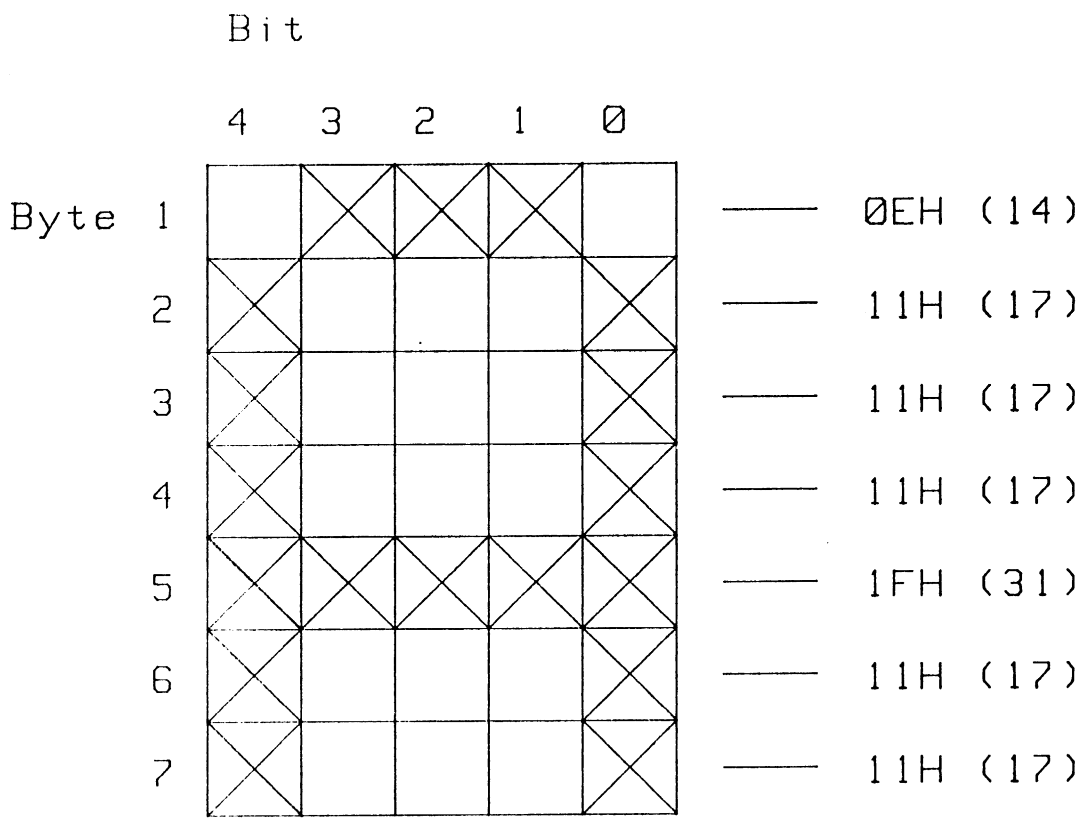
#I<C1><C2><C3><C4><C5><C6><C7><C8><SR3>

where #I is the preamble
<Cn> is the data for character n

The data for each character consists of a 7 byte string. The total data length, including the preamble is 58 bytes. The data could be read into a Series 200 controller with the following sequence of statements:

```
DIM Char$[58]
      .
      .
OUTPUT @Sweeper;"RC"
ENTER @Sweeper USING "%,-K";Char$
```

39. Each byte of the character data represents one row of pixels of the character. Note that since the LCD character cell is a 5 by 7 matrix, only the 5 least significant bits are used. This diagram shows how the data relates to the character cell.



40. When programmable character data is sent to the sweeper using the WC command, information for characters 1 and 2 only is allowed.
The transfer has the following format:

WC#I<C1><C2><SR3>

where #I is the preamble
<Cn> is the data for character n

41. A typical statement transfering programmable character data to the sweeper from a Series 200 controller would be:

OUTPUT @Sweeper USING "#,K";"WC"&Char1$&Char2$ END

where the data for characters 1 and 2 is contained in Char1$ and Char2$ respectively.

INSTRUMENT SETTINGS TRANSFER

42. The current values of all instrument parameters are stored in a block of memory in the sweeper. The RS and WS commands provide the means to read and write this data. The data is stored in a binary format and it is not intended that the user should extract parameter values from it since a binary programming facility already exists. The commands are provided to allow external storage and retrieval of instrument settings data, thus supplementing the internal memories.

43. The RS command instructs the sweeper to output the settings data when next addressed to talk:

RS<SR1>/<SR2>/<SR3>

The output format is as follows:

#J<settings data><checksum><SR3>

where	#J	is the preamble for binary data with checksum
	<settings data>	is a block of 305 bytes
	<checksum>	is a single byte calculated as the sum of all the bytes in <settings data> MODULO 256

This format is also used when writing data with the WS command.

44. A typical read/write instrument settings sequence for a Series 200 controller would be:

```
DIM Settings$[308]
        .
        .
OUTPUT @Sweeper;"RS"
ENTER @Sweeper USING "%,-K";Settings$
        .
        .
OUTPUT @Sweeper USING "#,K";"WS"&Settings$ END
```

45. The checksum is important since corrupted settings data could cause the sweeper operating system to enter an undefined state. Data is not accepted unless a valid checksum byte is present.

PROGRAMMABLE KEY DEFINITION TRANSFER

46. The six user programmable keys on the sweeper may be defined using the built in editor. Each key definition allows different combinations of parameters to be displayed on the LCD and assigned to the soft-keys. The RU and WU GPIB commands provide a means to read and write the programmable key data, allowing external storage and retrieval of many sets of definitions.

47. The data for each key is stored in a binary format with a checksum byte in a similar manner to the instrument settings data previously described. Once again, the commands are provided for the express purpose of data storage and retrieval only. It is not intended that information should be extracted from this data.

48. Data may be read from, and written to, any of the six programmable key definition stores. The RU command instructs the sweeper to output the definition data when next addressed to talk:

RU<key number><SR1>/<SR2>/<SR3>

where <key number> is an ASCII number (1-6)

The output format is as follows:

#J<key data><checksum><SR3>

where #J is the preamble for binary data with checksum
<key data> is a block of 38 bytes
<checksum> is a single byte calculated as the sum of all the bytes in <key data> MODULO 256

This format is also used when writing data with the WU command.

49. A typical read/write programmable key data sequence for a Series 200 controller would be:

```
DIM Pkey3$[41]
        .
        .
OUTPUT @Sweeper;"RU3"
ENTER @Sweeper USING "%,-K";Pkey3$
        .
        .
OUTPUT @Sweeper USING "#,K";"WU3"&Pkey3$ END
```

SRQ OPERATION

50. The SRQ facility is provided to allow the sweeper to interrupt the controller when a particular event has occured. This technique is often preferable to a scheme where the controller has to monitor the sweeper status constantly, checking for a particular condition.

51. The sweeper can generate SRQ interrupts on an number of different events. The SQ command allows the user to define which events, if any, will generate interrupts. The format for the SQ command is:

SQ<SRQ mask><SR1>/<SR2>/<SR3>

where <SRQ mask> is a string of 5 ASCII characters which must be either "0" or "1".

52. The character "0" disables a particular event from generating interrupts, while "1" enables interrupts on that event. This scheme allows any combination of the five events to be enabled. The characters of <SRQ mask> are allocated to events as follows:

Character	Event
1	End of sweep
2	Error condition encountered
3	RF output unlevelled
4	Front panel key pressed
5	SRQ interrupt on private bus

53. On a Series 200 controller the following statement will enable interrupts on error and private bus SRQ:

OUTPUT @Sweeper;"SQ01001"

and

OUTPUT @Sweeper;"SQ00000"

disables all interrupts from the sweeper.

54. The sweeper can be instructed to output the current SRQ mask with the OPSQ command. The output should be read into a string variable in order to preserve leading zeros if the value is to be subsequently used with the SQ command. The following statements on a Series 200 controller would read the current SRQ mask:

```
OUTPUT @Sweeper;"OPSQ"
ENTER @Sweeper;Srq_mask$
```

55. When an SRQ interrupt is generated by the sweeper the controller should respond with a serial poll sequence (note that parallel polling is not supported by the sweeper firmware). This causes the sweeper to make its status byte available to the controller. When the status byte is read the sweeper releases the SRQ bus line.

56. The status byte allows the controller to determine if it was, in fact, the sweeper which generated the SRQ and, if so, which event was the cause. The bits of the status byte are used as follows:

Bit	Meaning
7	Not used (always 0)
6	0 = SRQ inactive, 1 = SRQ active
3-5	Not used (always 0)
0-2	Decimal value indicates interrupting event

Value	Event
0	Not used
1	End of sweep
2	Error condition encountered
3	RF output unlevelled
4	Front panel key pressed
5	SRQ interrupt on private bus
6	Not used
7	Not used

57. The following Series 200 controller program segment enables the sweeper to generate SRQ interrupts on an error condition. The interrupt service routine reads the error number from the sweeper and displays it on the controller CRT.

```
OUTPUT @Sweeper;"SQ01000"
ON INTR 7 GOSUB Service
ENABLE INTR 7;2
        .
        .
Service: !
!
Status_byte=SPOLL(@Sweeper)
IF BIT(Status_byte,6) THEN
  OUTPUT @Sweeper;"OPER"
  ENTER @Sweeper;Error_number
  DISP "Sweeper error: ";Error_number
END IF
ENABLE INTR 7
RETURN
```

RESPONSE TO DEVICE CLEAR AND THE IP COMMAND

58. DEVICE CLEAR is a mechanism provided by the GPIB interface for returning the connected devices to a known state. Two types of DEVICE CLEAR are defined, UNIVERSAL and SELECTIVE. UNIVERSAL DEVICE CLEAR affects all connected devices, while SELECTIVE DEVICE CLEAR affects only the devices addressed to listen.

59. Two aspects of the effect of DEVICE CLEAR on the sweeper will be considered. First, the effect of DEVICE CLEAR on the sweeper GPIB interface is defined. When a DEVICE CLEAR message is received the sweeper interface may be in one of four states:

LOCAL
REMOTE
LOCAL with LOCAL LOCKOUT
REMOTE with LOCAL LOCKOUT

UNIVERSAL DEVICE CLEAR has no effect on these states. SELECTIVE DEVICE CLEAR is the same with the exception that if the interface is in the LOCAL state before receipt then it will be in the REMOTE state afterwards since SELECTIVE DEVICE CLEAR involves addressing the sweeper.

60. The DEVICE CLEAR message also has a specific effect on the operating state of the sweeper, as distinct from the interface. On receipt of either UNIVERSAL or SELECTIVE DEVICE CLEAR the following actions are performed:

Flush GPIB buffers
Reset error number to zero
Clear SRQ mask (all SRQ interrupts disabled)

All other aspects of the sweeper operating state are unaffected.

61. Another method of setting the sweeper to a known state is the IP (Instrument Preset) GPIB command. This has the effect of setting the instrument parameters to their preset values as shown in Table 4. Parameters not listed in Table 4 are not affected by the IP command. Table 4 is reproduced in Appendix G.

TABLE 4 - PRESET SETTINGS

FREQUENCY PARAMETERS

Parameter	Value	Units
Start frequency	2	GHz
Stop frequency	20	GHz
Centre frequency	11	GHz
Delta frequency	18	GHz
Marker A frequency	11	GHz
Marker B frequency	11	GHz
Marker C frequency	11	GHz
Marker D frequency	11	GHz
Marker E frequency	11	GHz
Reference marker frequency	11	GHz
Marker delta frequency	0	GHz
Frequency increment	0.5	GHz
Amplitude modulation frequency	1	kHz

POWER PARAMETERS

Parameter	Value	Units
Power level	0 (1)	dBm (mW)
Start power level	0 (1)	dBm (mW)
Stop power level	0 (1)	dBm (mW)
Power level increment	1 (1)	dBm (mW)
Slope	0	dB/GHz

TIME PARAMETERS

Parameter	Value	Units
Sweep time	100	ms
Sweep time increment	10	ms

TABLE 4 - PRESET SETTINGS - continued

MARKER CONTROL PARAMETERS

Parameter	Value
Reference marker	0 (A)
Stop marker	1 (B)
Marker mask	0 (All disabled)
Marker sweep	0 (OFF)

OPERATING MODE PARAMETERS

Parameter	Value
Operating mode	2 (Fl-F2)
Vernier mode	0 (OFF)
Sweep mode	0 (Internal)
Sweep trigger mode	0 (Internal)
Levelling control mode	0 (Internal)
RF	0 (OFF)
Amplitude modulation	0 (OFF)
RF blanking	1 (Retrace)
CW filter	1 (ON)
Counter trigger	0 (OFF)
Alternate sweep	0 (OFF)
Alternate sweep manual select	0 (Current settings)

MISCELLANEOUS PARAMETERS

Parameter	Value
Alternate sweep memory	0 (Current settings)
Integer increment	1

TABLE 4 - PRESET SETTINGS - continued

DIAGNOSTIC PARAMETERS

Parameter	Value
Ramp DAC	0
Offset DAC	0
Level DAC	0
Scale DAC	0
Vernier DAC	0
Band switch	0
PP1(A)	0
PP1(B)	0
Control RAM	0
Programmable latch	0

BUS HOLD-OFF FACILITY

62. When the sweeper receives GPIB commands it places them initially in a buffer from where another part of the firmware retrieves them for processing. This technique allows the sweeper to receive commands even when it is unable to process them immediately. In some cases it may be necessary to determine that a string of commands has been processed before continuing to another section of the program. A special command, HBUS, is provided for this purpose.

63. When the HBUS command is recognised at the GPIB interface further data handshaking is inhibited until all commands already in the input buffer have been processed.

64. Consider the following Series 200 controller program segment:

```
OUTPUT @Sweeper;"MO2,FA2GZ,FB20GZ,PL0DB,ST100MS,HBUS"
CALL Measurement
```

The CALL to Measurement will be made only when all the commands in the OUTPUT statement (together with any which may already be in the input buffer) have been processed.

Note that the HBUS command must be immediately preceeded by a valid separator.

COMMUNICATION WITH THE PRIVATE BUS SYSTEM

65. The private bus system is designed to serve three main purposes:

(i) Control of a Marconi 6500 amplitude analyser providing an integrated scalar measurement system.

(ii) Control of an HPGL compatible digital plotter providing hard copy of measurements made with the 6500.

(iii) Control of a Marconi 2440 counter and 6960 power meter providing an auto-calibration facility.

66. In these applications the sweeper acts as a GPIB controller and the private bus is normally entirely independent of the system bus. However, there may be occasions when it is desirable for an external controller connected to the system to be able to communicate with devices connected to the private bus.

67. Consider, for example, a 6500 amplitude analyser connected to the private bus. The sweeper responds to the analyser front panel controls and provides various operational enhancements. A controller connected to the system bus has some indirect control over the analyser by direct control of the sweeper. If the sweeper frequency range is changed, for example, the annotation on the 6500 display is updated and re-normalisation is performed if necessary. This level of control may be adequate for simple automated measurements. It may be required, however, to retrieve measurement data from the 6500 for analysis or storage. To satisfy this requirement the private bus PASS THROUGH facility is provided.

68. The sweeper responds to two distinct addresses on the system bus. The system address is used for all normal control functions. The private address may be used to communicate with devices connected to the private bus. Both addresses may be set from the front panel in the STATUS 2 configuration. The private address may also be set by GPIB control with the PR command as follows:

PR<address><SR1>/<SR2>/<SR3>

where <address> is a number in the range 0-30.

The private address is preset to 18. Note that the sweeper will not allow the private address to be set to the same value as the system address.

69. Since this address must serve all devices connected to the private bus it is necessary to tell the sweeper with which device communication is to take place. This is accomplished with the PT command as follows:

PT<address><SR1>/<SR2>/<SR3>

where <address> is a number in the range 0-30. Note that in this case the address must consist of two digits (e.g. 08).

70. All commands sent to the private address are passed to the device specified by the most recent PT command. Although any value between 0 and 30 may be specified, the sweeper assumes the following addresses for devices connected to the private bus:

Amplitude analyser	08
Digital plotter	05
Counter	06
Power meter	09

71. At power-on the sweeper determines which devices are connected to the private bus. If additional devices are connected after power-on the sweeper will not be able to communicate with them until the private bus system is re-initialised. This may be accomplished from the front panel in the PRIVATE configuration, or with the BP (bus preset) command.

72. The presence of a particular device may be established with one of the following commands:

OPAP **Output analyser present**
OPPP **Output plotter present**
OPCP **Output counter present**
OPMP **Output power meter present**

73. Following one of these commands the sweeper will output 1 if the device is connected, and 0 if it is not.

74. All transactions on the private bus are normally terminated with the line feed (LF) character and the EOI signal. Some pass through applications (for example binary transfers from 6500) require the use of the EOI signal only. The TM command provides the ability to specify which terminating conditions are used for subsequent pass through transactions as follows:

TM<separator type><SR1>/<SR2>/<SR3>

where <separator type> is either 0 for LF and EOI or 1 for EOI only.

75. The following Series 200 controller program segment reads the numeric value of the 6500 brightline frequency and the binary measurement data from channel A.

```
ASSIGN @Sweeper TO 719                  ! system address
ASSIGN @Private TO 718                  ! private address
DIM Binary$[846]                        ! Variable for binary data
          .
          .
OUTPUT @Sweeper;"PT08"                  ! 6500 pass through address
OUTPUT @Sweeper;"TM0"                   ! LF and EOI separator
OUTPUT @Private;"RF"                    ! 6500 read frequency command
ENTER @Private;Frequency                ! Read frequency
OUTPUT @Private;"RYA"                   ! 6500 read binary A command
OUTPUT @Sweeper;"TM1"                   ! EOI separator only
ENTER @Private USING "%,-K";Binary$     ! Read 6500 binary data
```

The private bus commands are summarised in Appendix E.

76. Pass through transactions are interleaved with the normal private bus operations. When using this facility the following points should be remembered:

(i) Normal private bus operations may cause data waiting to be sent by a device in response to a pass through request to be lost. If, for example, a key on the analyser front panel was pressed between execution of the

OUTPUT @Private;"RF"

and

ENTER @Private;Frequency

statements in the above program then the frequency data will be lost since part of the sweepers response to the key press involves reading data from the 6500. In this situation a null string will be output to the controller.

(ii) The sweeper will not be aware of any changes made using GPIB pass through to the settings of devices connected to the private bus. For example, if the analyser measurement channel is changed by pass through the sweeper will not re-write the 6500 screen annotation.

It is recommended that pass through transactions are restricted to the retrieval of data and status information.

TRANSFER OF CALIBRATION DATA USING GPIB

77. The sweeper has the ability to perform an automatic calibration using a counter and power meter connected to the private bus. In addition to this facility various operations connected with calibration may be performed using the system bus. A software package which allows complete calibration of the sweeper using the system bus is avaliable and, for this reason, only brief information on the transfer of calibration data is given. The information given is sufficient to allow storage and retieval of calibration data and various other operations to be performed.

78. All the GPIB commands associated with calibration are prefixed by CL.

79. In order to maintain the calibration security provided by manual operation a system of authorisation codes is used. Two levels of authorisation are provided by the commands CLC1 and CLC2 which have the following format:

CLC1<code 1>

CLC2<code 2>

where <code 1> and <code 2> are the six digit authorisation codes provided with the sweeper for manual operation.

80. Initially, all calibration commands, with the exception of output and binary read commands, are 'locked' and will be ignored. CLC1 'unlocks' all the calibration commands except CLTR which is used to transfer data from one of the user calibration stores to the primary store. CLLK allows the unlocked commands to be 're-locked'. The CLTR command is unlocked by CLC2 and is automatically re-locked after use.

81. The calibration data transfer commands are listed in table 6 and have the following general format:

<read command><store><SR1>/<SR2>/<SR3>

where <store> is 0, 1 or 2 indicating Primary, User 1 or User 2
and <read command> is of the form:

CLRx

where x indicates the data to be transfered (F, L or P).

The data returned has the following general format:

#J<calibration data><checksum><SR3>

82. The calibration write commands allow data in the same format to be written to the sweeper as follows:

<write command><store>#J<calibration data><checksum><SR3>

where <store> is 1 or 2 indicating User 1 or User 2
and <write command> is of the form:

CLWx

where x indicates the data to be transfered (F, L or P).

Note that the only way to change the data in the Primary store is to use the CLTR command, transfering data from either User 1 or User 2.

TABLE 6 - CALIBRATION DATA TRANSFER COMMANDS

MNEMONIC	DATA LENGTH	DESCRIPTION
CLRF/CLWF	584 bytes	Read/write frequency data
CLRL/CLWL	514 bytes	Read/write power linearity data
CLRP/CLWP	580 bytes	Read/write power flatness data

Note: The data length does not include the #J preamble or the checksum.

83. Table 7 summarises the additional commands relating to calibration. The calibration currently in use may be selected by CLSL when unlocked with CLC1. The calibration identification number associated with each of the two user stores may be read at any time and changed when the command is unlocked with CLC1. The calibration time may be read at any time and reset to zero when the command is unlocked with CLC1. Note that the calibration time is not reset automatically (as it is with the internal calibration facility) since it is possible to only partially update the calibration data (e.g. power only). It is therefore the user's responsibility to reset the calibration time if required.

TABLE 7 - MISCELLANEOUS CALIBRATION COMMANDS

MNEMONIC	LEVEL	VALUE RANGE	DESCRIPTION
CLC1	0	<6 digits>	Unlock level 1 commands
CLLK	1		Lock level 1 commands
CLC2	1	<6 digits>	Unlock CLTR command
CLSL	1	0/2	Select current calibration data 0: Primary 1: User 1 2: User 2
CLTR	2	1/2	Transfer data from User 1/2 to Primary store. (Identification code and time travels with data).
CLID	1	1/2 <8 digits>	Write calibration identification code to User 1 or User 2 stores.
OPCLID	0	0/2	Read calibration identification code from Primary, User 1 or User 2 stores.
CLRT	1	1/2	Reset calibration time for User 1 or User 2.
OPCLTM	0	0/2	Read calibration time for Primary, User 1 or User 2.

84. The following Series 200 controller program segment unlocks level 1 commands, reads frequency calibration data from User 1, writes this data to User 2 changing the identification code and resetting the calibration time, and finally transfers the data from User 2 to the Primary store. The authorisation codes used are, of course, ficticious.

```
DIM F_data$[587]                                     ! Allocate variable
        .
        .
OUTPUT @Sweeper;"CLC1123456"                         ! Unlock commands
OUTPUT @Sweeper;"CLRF1"                              ! Read User 1 data
ENTER @Sweeper USING "%,-K";F_data$
OUTPUT @Sweeper USING "#,K";"CLWF2"&F_data$ END      ! Send to User 2
OUTPUT @Sweeper;"CLID219118501"                      ! Change User 2 ID
OUTPUT @Sweeper;"CLRT2"                              ! Reset User 2 time
OUTPUT @Sweeper;"CLC2654321"                         ! Unlock CLTR
OUTPUT @Sweeper;"CLTR2"                              ! User 2 > Primary
OUTPUT @Sweeper;"CLLK"                               ! Re-lock commands
```

Appendix A

INTERFACE CAPABILITIES

1. **SH1** Source Handshake - complete capability

   The source handshake sequences the transmission of each data byte from the instrument over the bus data lines. The sequence is initiated when the function becomes active, and the purpose of the function is to synchronize the rate at which bytes become available to the rate at which accepting devices on the bus can receive the data.

2. **AH1** Acceptor Handshake - complete capability

   The acceptor handshake sequences the reading of data bytes from the bus lines.

3. **T6** Talker Function - no TALK ONLY function

   The talker function provides the sweeper with the ability to send device dependent messages over the bus to other devices. The ability to talk exists only when the instrument has been addressed as a talker.

4. **L4** Listener Function - no LISTEN ONLY function

   The listener function provides a device with the ability to receive device dependent messages over the bus. The capability exists only when the device is addressed to listen by the controller.

5. **SR1** Service Request Function - complete capability

The service request function gives the sweeper the ability to interrupt the controller and request attention. The sweeper can be enabled to issue the interrupt on the occurence of a number of different events and returns a STATUS BYTE indicating the source of the interrupt when interrogated by the SERIAL POLL technique.

6. **RL1** Remote/Local Function - complete capability

The remote/local function allows the sweeper to be controlled either locally by the front panel controls, or remotely by device dependent messages over the bus.

7. **PP0** Parallel Poll Function - no capability

8. **DC1** Device Clear Function - complete capability

The device clear function is a general reset and may be given to all devices in the system (DCL - DEVICE CLEAR) or only to addressed devices (SDC - SELECTED DEVICE CLEAR). Actions performed by the sweeper on receipt of DCL or SDC are described in Chapter 2.

9. **DT0** Device Trigger function - no capability

10. **E2** Bus Driver Type

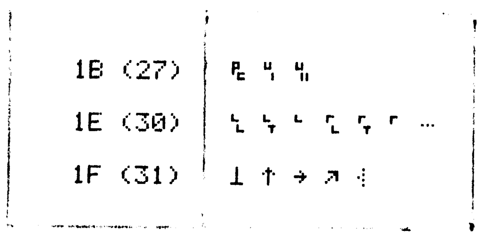
The GPIB driver devices fitted in the sweeper have tri-state, rather than open collector, outputs.

Appendix B

SWEEPER LCD CHARACTER SET AND TEXT CONTROL CODES

1. These diagrams show the LCD character set and the various forms of the pre-defined programmable characters.

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0																
1									■	■		₧	Δ	µ	⌞	⊥
2		!	"	#	$	%	&	'	(	)	*	+	,	-	.	/
3	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
4	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
5	P	Q	R	S	T	U	V	W	X	Y	Z	[	¥	]	^	_
6	`	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
7	p	q	r	s	t	u	v	w	x	y	z	{	|	}	→	←



Programmable character allocation

Character	Dec	Hex	Function
1	24	18	User-defined
2	25	19	User-defined
3	26	1A	Not used (blank)
4	27	1B	Cal type indicator
5	28	1C	Delta character
6	29	1D	Mu character
7	30	1E	GPIB status indicator / dots
8	31	1F	Mode indicator / vertical bar

TEXT CONTROL CODES

Dec	Hex	Function
1	1	Home (text pointer set to top left of LCD)
2	2	Clear current line (text pointer set to beginning)
7	7	Move text pointer right
8	8	Move text pointer left
10	A	Move text pointer down (line feed)
11	B	Move text pointer up
12	C	Clear screen (text pointer set to top left)
13	D	Carriage return
14	E	Enable flashing characters (Note 1)
15	F	Disable flashing characters (Note 1)
16	10	Clear field (Note 1)
17	11	Set text pointer to XY coordinates (Note 2)

Notes:

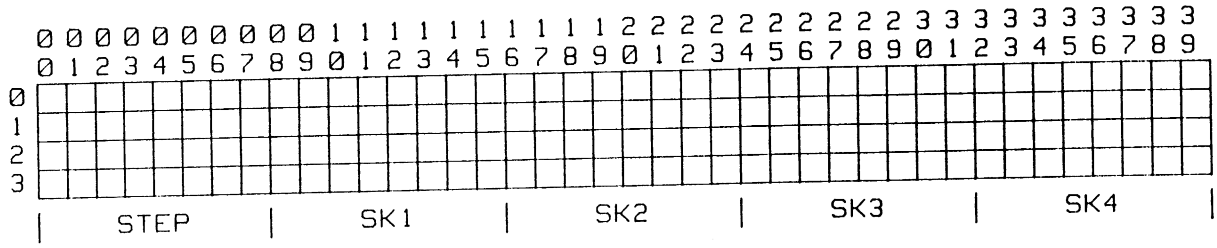
1. Followed by a byte (1-160) indicating the range.
2. Followed by 2 bytes:

   i. (0-39) indicating X location
   ii. (0-3) indicating Y location

Appendix C

STANDARD LCD LAYOUT SHEET

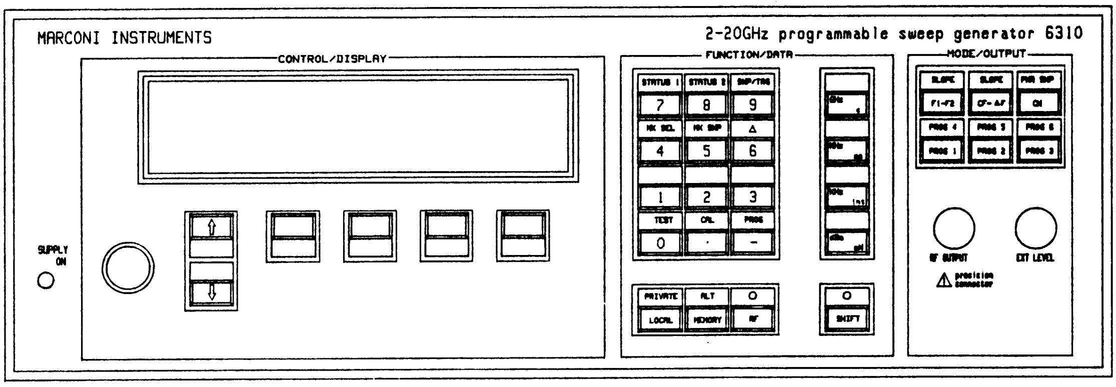
1. This sheet may be used to prepare LCD text layouts for use with the WT command.



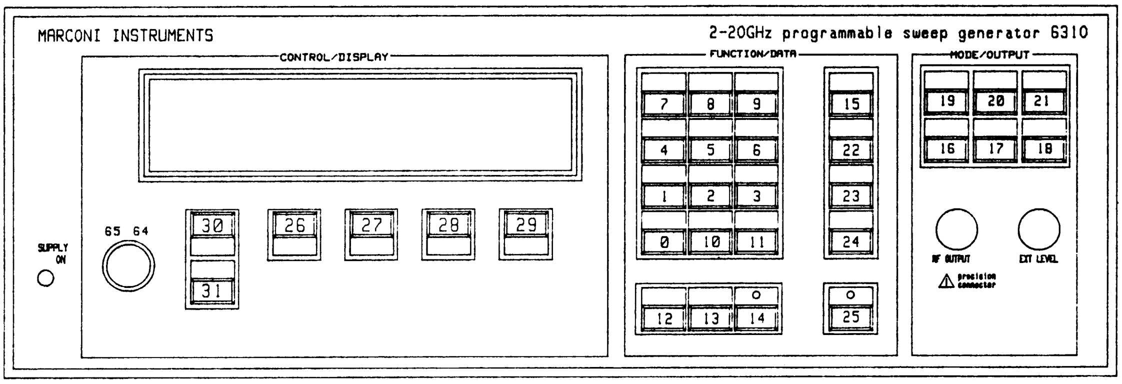
Appendix D

KEYBOARD CODES

1. This diagram shows the keyboard codes sent by the sweeper in response to the OPLK command.



Key designations



Equivalent keyboard codes

Appendix E

GPIB COMMAND SUMMARY

1. Table 1 gives details of all sweeper GPIB commands which allow control of the instrument parameters described in Chapter 1. The table gives the following information for each command:

   (i) The mnemonic. This may be prefixed with [OP] indicating that the command has READ/WRITE status. More information on reading parameter values is given in the next section. Some commands have READ ONLY status and are always prefixed by OP.

   (ii) The allowable range of values (if any).

   (iii) The allowable terminators (if any).

   (iv) A brief desciption of the purpose of the command.

TABLE 1 - GPIB COMMANDS FOR PARAMETER CONTROL

FREQUENCY PARAMETERS - Output format: DDD.DDDDDD (GHz)

MNEMONIC	VALUE RANGE	TERMINATORS	DESCRIPTION
[OP] FA	1.9/20.1GHz	GZ/MZ/KZ/HZ	[Output] Start frequency.
[OP] FB	1.9/20.1GHz	GZ/MZ/KZ/HZ	[Output] Stop frequency.
[OP] CF	1.9/20.1GHz	GZ/MZ/KZ/HZ	[Output] Centre frequency in sweep mode, or CW frequency in CW mode.
[OP] DF	0/18.2GHz	GZ/MZ/KZ/HZ	[Output] Delta frequency symmetrical about centre frequency.
[OP] MKFA	1.9/20.1GHz	GZ/MZ/KZ/HZ	[Output] Marker A frequency.
[OP] MKFB	1.9/20.1GHz	GZ/MZ/KZ/HZ	[Output] Marker B frequency.
[OP] MKFC	1.9/20.1GHz	GZ/MZ/KZ/HZ	[Output] Marker C frequency.
[OP] MKFD	1.9/20.1GHz	GZ/MZ/KZ/HZ	[Output] Marker D frequency.
[OP] MKFE	1.9/20.1GHz	GZ/MZ/KZ/HZ	[Output] Marker E frequency.
[OP] MKFR	1.9/20.1GHz	GZ/MZ/KZ/HZ	[Output] Reference marker frequency.
OPMKDF			Output marker delta frequency.
[OP] FD	0/10GHz	GZ/MZ/KZ/HZ	[Output] Frequency increment.
[OP] MF	1/100kHz	GZ/MZ/KZ/HZ	[Output] Amplitude modulation frequency.

Note: Output format for OPMF is DDD.DDD (kHz).

TABLE 1 - GPIB COMMANDS FOR PARAMETER CONTROL - continued

POWER PARAMETERS - Output format: SDD.DDD (dB)

MNEMONIC	VALUE RANGE	TERMINATORS	DESCRIPTION
[OP] PL	-15/20dBm 0.031622/100	DB MW	[Output] Power level.
[OP] PA	-15/20dBm 0.031622/100	DB MW	[Output] Start power level. Same parameter as [OP] PL.
[OP] PB	-15/20dBm 0.031622/100	DB MW	[Output] Stop power level.
[OP] PD	0/5dB 0.1/20mW	DB MW	[Output] Power increment.
[OP] SL	0/20dB	DB	[Output] Power slope (dB/GHz).

Note: Output of power parameters is in dB(m) ONLY.

TIME PARAMETERS - Output format: DDDDD.D (ms)

MNEMONIC	VALUE RANGE	TERMINATORS	DESCRIPTION
[OP] ST	10ms/33.5s	SC/MS	[Output] Sweep time.
[OP] S1			Same as [OP] ST.
[OP] TD	1ms/10s	SC/MS	[Output] Sweep time increment.

TABLE 1 - GPIB COMMANDS FOR PARAMETER CONTROL - continued

MARKER CONTROL PARAMETERS - Output format: NR1

MNEMONIC	VALUE RANGE	TERMINATORS	DESCRIPTION
[OP] MKRS	0/4		[Output] Select[ed] reference marker A/E.
[OP] MKSS	0/4		[Output] Select[ed] stop marker A/E.
[OP] MKMA	0/31		[Output] Marker mask.
[OP] MKRE	0/1		[Output] Reference marker disabled/enabled.
MKAE	0/1		All markers disabled/enabled.
MKCF			Assign reference marker frequency to centre frequency.
[OP] MKSW	0/1		Marker sweep off/on (reference -> stop).
MKTR			Transfer values of reference and stop markers to start and stop frequencies (make marker sweep permanent).

TABLE 1 - GPIB COMMANDS FOR PARAMETER CONTROL - continued

OPERATING MODE PARAMETERS - Output format: NR1

MNEMONIC	VALUE RANGE	TERMINATORS	DESCRIPTION
[OP] MO	0/3		[Output] Operating mode. 0: CW 1: Power sweep 2: F1-F2 3: Power slope
[OP] VN	0/1		[Output] Vernier off/on (CW only).
[OP] SW	0/1		[Output] Sweep mode. 0: Internal 1: External
[OP] TR	0/3		[Output] Sweep trigger mode. 0: Internal 1: External 2: Line 3: Single
SS			Trigger single sweep.
OPSS	0/2		Output single sweep status. 0: Ready 1: Sweeping 2: Inactive
[OP] LC	0/3		[Output] Levelling control mode 0: Internal 1: External (+ve) 2: External (-ve) 3: Power meter.
OPLV	0/1		Output levelled off/on.
[OP] RF	0/1		[Output] RF off/on.
[OP] MD	0/1		[Output] Amplitude modulation off/on.
[OP] BL	0/1		[Output] RF blanking off/on.
[OP] FL	0/1		[Output] CW filter off/on.
[OP] CT	0/3		[Output] Counter trigger point. 0: Off 1: F1 2: F2 3: Reference marker
[OP] AM	0/2		[Output] Alternate sweep mode. 0: Off 1: Manual 2: Auto
[OP] AS	0/1		Alternate sweep manual select. 0: Current settings 1: Memory settings

TABLE 1 - GPIB COMMANDS FOR PARAMETER CONTROL - continued

MISCELLANEOUS PARAMETERS - Output format: NR1

MNEMONIC	VALUE RANGE	TERMINATORS	DESCRIPTION
[OP] CH	0/23		[Output] Clock hours.
[OP] CM	0/59		[Output] Clock minutes.
[OP] CS	0/59		[Output] Clock seconds.
OPTT			Output total 'power on' time.
[OP] UT	0/99999		[Output] User time.
[OP] VA	1/20		[Output] LCD viewing angle (contrast).
MEMS	1/20		Store instrument settings.
MEMR	1/21		Recall instrument settings. 21 recalls preset settings.
[OP] MEMA	0/20		[Output] Memory used for alternate sweep. 0 selects current settings.
OPLK			Output code of last key pressed. See diagram in Appendix D for key codes.
OPER			Output code of last error. See Appendix H for error codes.
OPIS			Output firmware issue status.
OPSN			Output instrument serial number.
[OP] ID	1/65535		[Output] Integer increment.

TABLE 1 - GPIB COMMANDS FOR PARAMETER CONTROL - continued

DIAGNOSTIC PARAMETERS - Output format: NR1

MNEMONIC	VALUE RANGE	TERMINATORS	DESCRIPTION
[OP] DCRM	0/4095		[Output] Ramp DAC value.
[OP] DCOS	0/65535		[Output] Offset DAC value.
[OP] DCLL	0/65535		[Output] Level DAC value.
[OP] DCSC	0/65535		[Output] Scale DAC value.
[OP] DCVN	0/4095		[Output] Vernier DAC value.
[OP] DCBA	0/2		[Output] Band switch value.
[OP] DCCA	0/255		[Output] PPI(A) value.
[OP] DCCB	0/255		[Output] PPI(B) value.
[OP] DCCC	0/65535		[Output] Control RAM value.
[OP] DCPG	0/15		[Output] Programmable latch value.

Note: The diagnostic parameters are included here for completeness but are not designed for use in normal applications. Further information on these commands is not given in this manual.

TABLE 3 - KEYPRESS MNEMONICS

UNSHIFTED FUNCTION	SHIFTED FUNCTION	MNEMONIC
STEP UP	-	KS (or UP)
STEP DOWN	-	KT (or DN)
SOFT KEY 1	-	KO
SOFT KEY 2	-	KP
SOFT KEY 3	-	KQ
SOFT KEY 4	-	KR
0	TEST	K0
1	-	K1
2	-	K2
3	-	K3
4	MK SEL	K4
5	MK SWP	K5
6	DELTA	K6
7	STATUS 1	K7
8	STATUS 2	K8
9	SWP/TRIG	K9
.	CAL	K.
-	PROG	K-
GHz / s	-	KD
MHz / ms	-	KK
KHz / int	-	KL
dBm / mW	-	KM
F1-F2	SLOPE	KH
CF-dF	SLOPE	KI
CW	PWR SWP	KJ
PROG 1	PROG 4	KE
PROG 2	PROG 5	KF
PROG 3	PROG 6	KG
LOCAL	PRIVATE	KA
MEMORY	ALT	KB
RF	-	KC
SHIFT	-	KN
ROTARY CONTROL:		
CLOCKWISE	-	KU
ANTI-CLOCKWISE	-	KV

TABLE 6 - CALIBRATION DATA TRANSFER COMMANDS

MNEMONIC	DATA LENGTH	DESCRIPTION
CLRF/CLWF	584 bytes	Read/write frequency data.
CLRL/CLWL	514 bytes	Read/write power linearity data.
CLRP/CLWP	580 bytes	Read/write power flatness data.

Note: The data length does not include the #J preamble or the checksum.

TABLE 7 - MISCELLANEOUS CALIBRATION COMMANDS

MNEMONIC	LEVEL	VALUE RANGE	DESCRIPTION
CLC1	0	<6 digits>	Unlock level 1 commands
CLLK	1		Lock level 1 commands
CLC2	1	<6 digits>	Unlock CLTR command
CLSL	1	0/2	Select current calibration data 0: Primary 1: User 1 2: User 2
CLTR	2	1/2	Transfer data from User 1/2 to Primary store. (Identification code and time travels with data).
CLID	1	1/2 <8 digits>	Write calibration identification code to User 1 or User 2 stores.
OPCLID	0	0/2	Read calibration identification code from Primary, User 1 or User 2 stores.
CLRT	1	1/2	Reset calibration time for User 1 or User 2.
OPCLTM	0	0/2	Read calibration time for Primary, User 1 or User 2.

TABLE 8 - BINARY DATA TRANSFER COMMANDS

MNEMONIC	PREAMBLE	LENGTH	DESCRIPTION
RT	#I	160	Read text from LCD.
RC	#I	56	Read programmable character data.
WC	#I	14	Write programmable character data.
RS/WS	#J	305	Read/write instrument settings.
RU/WU	#J	38	Read/write programmable key setups.

Note: Transfers with a #J preamble are suffixed by a checksum byte which is calculated as:

checksum = SUM (all data bytes) MOD 256

Data lengths DO NOT include the preamble or checksum.

TABLE 9 - MISCELLANEOUS COMMANDS

These commands are not tabulated elsewhere in this manual

MNEMONIC	VALUE RANGE	DESCRIPTION
WT	"<text>"	Write text to LCD. <text> = ASCII characters or control codes.
[OP] SQ	nnnnn	[Output] SRQ mask. n = "0" or "1".
IP		Return sweeper to preset settings.

TABLE 10 - PRIVATE BUS COMMANDS

This table summarises the private bus commands described in Chapter 2.

MNEMONIC	VALUE RANGE	DESCRIPTION
PR	0/30	Set private address.
PT	00/30	Set pass through address.
TM	0/1	Set pass through separator. 0 = Line feed (LF) and EOI, 1 = EOI only.
BP		Initialise private bus (bus preset).
OPAP	0/1	Output analyser present.
OPPP	0/1	Output plotter present.
OPCP	0/1	Output counter present.
OPMP	0/1	Output power meter present.

Appendix F

BINARY CONTROL CODE SUMMARY

1. Table 2 lists the parameters which can be accessed by binary control in the same order as Table 1 (See Appendix E). The following items of information are given:

   Normal control mnemonic - for cross-reference to Table 1.

   Brief description of parameter.

   Logical parameter number.

   Value of 1 LSB (least significant bit) where appropriate.

   Minimum value/Maximum value.

   For functional descriptions of parameters refer to Table 1.

TABLE 2 - BINARY PARAMETER CONTROL

FREQUENCY PARAMETERS

MNEMONIC	DESCRIPTION	LPN	LSB	RANGE
[OP] FA	Start frequency	1	1kHz	1900000/20100000
[OP] FB	Stop frequency	2	1kHz	1900000/20100000
[OP] CF	Centre/CW frequency	3	1kHz	1900000/20100000
[OP] DF	Delta frequency	4	1kHz	0/18200000
[OP] MKFA	Marker A frequency	5	1kHz	1900000/20100000
[OP] MKFB	Marker B frequency	6	1kHz	1900000/20100000
[OP] MKFC	Marker C frequency	7	1kHz	1900000/20100000
[OP] MKFD	Marker D frequency	8	1kHz	1900000/20100000
[OP] MKFE	Marker E frequency	9	1kHz	1900000/20100000
[OP] MKFR	Ref. marker frequency	10	1kHz	1900000/20100000
[OP] FD	Frequency increment	12	1kHz	0/10000000
[OP] MF	Modulation frequency	13	1Hz	1000/100000

TABLE 2 - BINARY PARAMETER CONTROL - continued

POWER PARAMETERS

MNEMONIC	DESCRIPTION	LPN	LSB	RANGE
[OP] PL	Power level	14	.001dBm	-15000/20000
[OP] PA	Same as [OP] PL			
[OP] PB	Stop power level	15	.001dBm	-15000/20000
[OP] PD	Power increment	16	.001dB	0/5000
[OP] SL	Power slope	17	.001dB	0/20000

Note: Binary control of power parameters is available only in dB(m).

TIME PARAMETERS

MNEMONIC	DESCRIPTION	LPN	LSB	RANGE
[OP] ST	Sweep time	21	.1ms	100/335000
[OP] S1	Same as [OP] ST			
[OP] TD	Sweep time increment	22	.1ms	10/100000

TABLE 2 - BINARY PARAMETER CONTROL - continued

MARKER CONTROL PARAMETERS

MNEMONIC	DESCRIPTION	LPN	LSB	RANGE
[OP] MKRS	Select ref. marker	70		0/4
[OP] MKSS	Select stop marker	71		0/4
[OP] MKMA	Marker mask	37		0/31
[OP] MKRE	Enable ref. marker	60		0/1
[OP] MKSW	Marker sweep off/on	65		0/1

OPERATING MODE PARAMETERS

MNEMONIC	DESCRIPTION	LPN	LSB	RANGE
[OP] MO	Operating mode	59		0/3
[OP] VN	Vernier off/on	69		0/1
[OP] SW	Sweep mode int/ext	52		0/1
[OP] TR	Trigger mode	50		0/3
[OP] LC	Levelling control mode	51		0/3
[OP] RF	RF off/on	53		0/1
[OP] MD	Amplitude mod off/on	54		0/1
[OP] BL	RF blanking off/on	55		0/1
[OP] FL	CW filter off/on	49		0/1
[OP] CT	Counter trigger point	48		0/3
[OP] AM	Alternate sweep mode	67		0/2
[OP] AS	Alt. sweep manual select	68		0/1

TABLE 2 - BINARY PARAMETER CONTROL - continued

MISCELLANEOUS PARAMETERS

MNEMONIC	DESCRIPTION	LPN	LSB	RANGE
[OP] CH	Clock hours	23	1hr	0/23
[OP] CM	Clock minutes	24	1min	0/59
[OP] CS	Clock seconds	25	1sec	0/59
[OP] UT	User time	27	1hr	0/99999
[OP] VA	Viewing angle (contrast)	28		1/20
[OP] MEMA	Alt. sweep memory	34		0/20
[OP] ID	Integer increment	29		1/65535

TABLE 2 - BINARY PARAMETER CONTROL - continued

DIAGNOSTIC PARAMETERS

MNEMONIC	DESCRIPTION	LPN	LSB	RANGE
[OP] DCRM	Ramp DAC	38		0/4095
[OP] DCOS	Offset DAC	39		0/65535
[OP] DCLL	Level DAC	40		0/65535
[OP] DCSC	Scale DAC	41		0/65535
[OP] DCVN	Vernier DAC	42		0/4095
[OP] DCBA	Band switch	43		0/2
[OP] DCCA	PPI(A)	44		0/255
[OP] DCCB	PPI(B)	45		0/255
[OP] DCCC	Control RAM	46		0/65535
[OP] DCPG	Programmable latch	47		0/15

PRIVATE GPIB PARAMETERS

MNEMONIC	DESCRIPTION	LPN	LSB	RANGE
[OP] PR	Private bus address	31		0/30

Appendix G

PRESET INSTRUMENT SETTINGS

1. Table 4 shows the preset instrument settings following the IP command.

TABLE 4 - PRESET SETTINGS

FREQUENCY PARAMETERS

Parameter	Value	Units
Start frequency	2	GHz
Stop frequency	20	GHz
Centre frequency	11	GHz
Delta frequency	18	GHz
Marker A frequency	11	GHz
Marker B frequency	11	GHz
Marker C frequency	11	GHz
Marker D frequency	11	GHz
Marker E frequency	11	GHz
Reference marker frequency	11	GHz
Marker delta frequency	0	GHz
Frequency increment	0.5	GHz
Amplitude modulation frequency	1	kHz

POWER PARAMETERS

Parameter	Value	Units
Power level	0 (1)	dBm (mW)
Start power level	0 (1)	dBm (mW)
Stop power level	0 (1)	dBm (mW)
Power level increment	1 (1)	dBm (mW)
Slope	0	dB/GHz

TIME PARAMETERS

Parameter	Value	Units
Sweep time	100	ms
Sweep time increment	10	ms

TABLE 4 - PRESET SETTINGS - continued

MARKER CONTROL PARAMETERS

Parameter	Value
Reference marker	0 (A)
Stop marker	1 (B)
Marker mask	0 (All disabled)
Marker sweep	0 (OFF)

OPERATING MODE PARAMETERS

Parameter	Value
Operating mode	2 (F1-F2)
Vernier mode	0 (OFF)
Sweep mode	0 (Internal)
Sweep trigger mode	0 (Internal)
Levelling control mode	0 (Internal)
RF	0 (OFF)
Amplitude modulation	0 (OFF)
RF blanking	1 (Retrace)
CW filter	1 (ON)
Counter trigger	0 (OFF)
Alternate sweep	0 (OFF)
Alternate sweep manual select	0 (Current settings)

MISCELLANEOUS PARAMETERS

Parameter	Value
Alternate sweep memory	0
Integer increment	1

TABLE 4 - PRESET SETTINGS - continued

DIAGNOSTIC PARAMETERS

Parameter	Value
Ramp DAC	0
Offset DAC	0
Level DAC	0
Scale DAC	0
Vernier DAC	0
Band switch	0
PP1(A)	0
PP1(B)	0
Control RAM	0
Programmable latch	0

Appendix H

GPIB ERROR CODES

1. The following table describes all the possible error codes sent by the sweeper in response to the OPER command. Codes with E status (ERROR) are those which may result in an unexpected outcome of the operation being performed. Codes with W status (WARNING) will not normally affect the outcome of the operation being performed but serve to alert the user that a condition exists which could affect operation in general.

TABLE 11 - ERROR CODES

ERROR CODE	STATUS	MEANING
1	E	Keyboard numeric entry causes generation of number exceeding MAXINT (the highest integer available to the sweeper operating system).
2	E	No room for insertion of parameter on display in PROG key editor.
3	E	More than 11 parameters selected in PROG key editor.
4	W	Power supply over-heated.
5	E	Numeric entry causes parameter limit to be exceeded.
6	E	External sweep mode renders operation invalid. Applies to external, line or single trigger, counter trigger and alternate sweep.
7	E	External sweep requested when counter trigger enabled.
8	E	External sweep requested when not in internal sweep trigger mode.
9	E	External sweep requested when alternate sweep enabled.
10	E	GPIB numeric entry causes generation of a number which exceeds MAXINT (the highest integer available to the sweeper operating system).

TABLE 10 - ERROR CODES - continued

ERROR CODE	STATUS	MEANING
11	E	GPIB numeric entry does not conform to formats defined in IEEE 728-1982 (NR1,NR2,NR3 and string data).
12	E	Premature separator received during transfer of binary data to sweeper.
13	E	No separator received following transfer of binary data to sweeper.
14	E	Calibration command received when commands not unlocked. Also generated when incorrect authorisation codes are sent with the CLC1 and CLC2 commands.
15	E	Invalid store number received with command relating to PROG key setups or calibration stores.
16	E	Out of range value received in binary parameter data, PROG key setup data, instrument settings data or WT text. Also generated for out of range values sent with the PT and TM commands.
17	E	Invalid preamble received during transfer of binary data to sweeper.
18	E	Invalid checksum received during transfer of binary data to sweeper.
19	E	Invalid GPIB command mnemonic received.
20	E	Attempt to store current instrument settings in the PRESET memory store.
21	E	Checksum error on instrument settings data recalled from memory.
22	E	Attempt to renormalise automatically on 6500 when F1 or F2 out of range or following a mode change.

Appendix I

GPIB CONNECTIONS

Connector contact assignments

1. The contact assignment of the GPIB lead assembly and the two device connectors is as shown in Fig. 1 below.

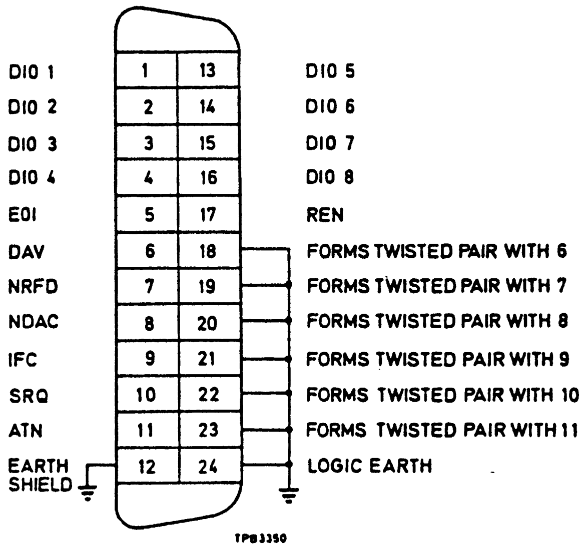


Fig. 1 GPIB connector contact assignments

2. Connection to other equipment which has a 24-way bus connector to IEEE Standard 488 can be made with the GPIB lead assembly 43129-189U, available as an optional accessory. An IEEE-to-IEC adapter 46883-408K is also available for interfacing with systems using a 25-way bus connector to IEC Recommendation 625 - see Fig. 2.

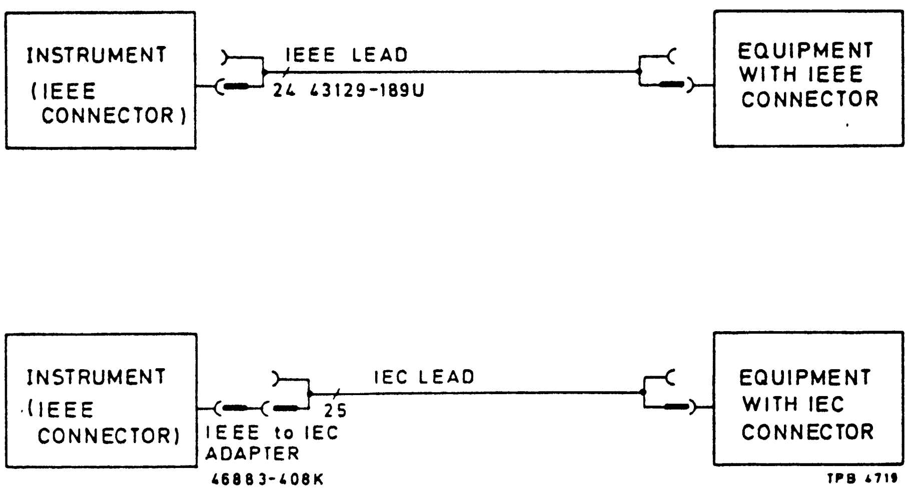


Fig. 2 GPIB interconnections

Interface bus lead connection

3. The leads for the interface bus use special male-female connectors at both ends. This allows several connectors to be stacked one on top of another permitting several leads to be connected to the same source and secured by a lockscrew mechanism. Too large a stack however, may form a centilevered structure which might cause damage and should be avoided. The piggyback arrangement permits star or linear interconnection between the devices forming a system with the restriction that the total lead length for the system must be:-

(1) No greater than 20 m (65 ft).

(2) No greater than 2 m (6 ft) times the total number of devices (including the controller) connected to the bus.