Linux-GPIB 3.2.06 Documentation

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1. Copying

2. Configuration

Configuration of the GPIB library is accomplished through the configuration file /etc/gpib.conf, and the administration program gpib_config.

gpib.conf

Name

`gpib.conf` — GPIB library configuration file

Description

The library, and the administration tool gpib_config read their configuration information from the file /etc/gpib.conf. A template gpib.conf file can be found in the util/templates/ subdirectory of the linux-gpib package.

The configuration file must contain one or more ’interface’ entries, and can contain zero or more ’device’ entries. ’device’ entries are only required if you wish to open device descriptors with ibfind() instead of using ibdev(). Several example entries, and a table summarizing the possible options follow.

```
interface {
 minor = 0
 board_type = "ni_pci"
 pad = 0
 master = yes
}

interface {
 minor = 1
 board_type = "ines_pci"
 name = "joe"
 pad = 5
 sad = 0
 timeout = T10s
 pci_bus = 0
 pci_slot = 0xd
 master = no
}

interface {
 minor = 2
 board_type = "pcII"
 pad = 3
 sad = 0x62
 eos = 0x0d
 set-reos = yes
 set-bin = no
 set-xeos = no
 set-eot = yes
 base = 0x300
 irq  = 5
 dma  = 0
 master = no
}

device {
 minor = 0
 name = "counter"
 pad = 24
}

device {
 minor = 0
 name = "voltmeter"
 pad = 7
 sad = 110
 eos = 0xa
```

```
 set-reos = yes
 set-bin = no
 set-xeos = yes
 set-eot = no
 timeout = T1s
}
```

Table 1. configuration options

option name	description	used by interface or device entries	required or op
base	Specifies the base ioport or io memory address for a board that lacks plug-and-play capability.	interface	optional
board_type	Specifies the type of interface board. See the drivers.txt file for a list of possible board types, and the kernel driver module that supports them.	interface	required
dma	Specifies the dma channel for a board that lacks plug-and-play capability.	interface	optional
eos	Sets the end-of-string byte for board or device descriptors obtained with ibfind(). See also the set-reos, set-bin, and set-xeos options.	interface or device	optional
irq	Specifies the interrupt level for a board that lacks plug-and-play capability.	interface	optional
master	Set to ’yes’ if you want the interface board to be the system controller of the bus. There can only be one system controller on a bus.	interface	required

option name	description	used by interface or device entries	required or op
minor	’minor’ specifies the minor number of the device file this interface board will use. A ’minor’ of 0 corresponds to /dev/gpib0, 1 is /dev/gpib1, etc. The minor number is also equal to the ’board index’ which can be used as a board descriptor, and is passed as one of the arguments of ibdev()	interface	required
name	The ’name’ specifies the name which can be used with ibfind() to get a descriptor for the board or device associated with this entry.	interface or device	optional
pad	Specifies the primary GPIB address (valid addresses are 0 to 30). For interfaces, this is the primary address that the board will be assigned when it is first brought online. For devices, this is address that will be used by device descriptors obtained with ibfind().	interface or device	required
pci_bus	Useful for distinguishing between multiple PCI cards. If you have more than one PCI card that with the same ’board_type’, you can use the ’pci_bus’ and ’pci_slot’ options to specify the particular card you are interested in.	interface	optional

option name	description	used by interface or device entries	required or op
pci_slot	Can be used in conjunction with 'pci_bus' to specify a particular pci card.	interface	optional
sad	Specifies the secondary GPIB address. Valid values are 0, or 0x60 to 0x7e hexadecimal (96 to 126 decimal). A value of 0 means secondary addressing is disabled (the default). Secondary addresses from 0 to 30 are specified by the library's convention of adding an offset of 0x60.	interface or device	optional
set-bin	Enables 8-bit comparisons when matching the end-of-string byte, instead of only comparing the 7 least significant bits. Only affects descriptors returned by ibfind(), and has same effect as setting the BIN bit in a ibeos() call.	interface or device	optional
set-eot	Enables assertion of the EOI line at the end of writes, for descriptors returned by ibfind(). See ibeot().	interface or device	optional
set-reos	Enables the termination of reads on reception of the end-of-string byte for descriptors returned by ibfind(). Same as setting the REOS bit in a ibeos() call.	interface or device	optional

option name	description	used by interface or device entries	required or op
set-xeos	Enables the assertion of EOI on transmission of the end-of-string byte for descriptors returned by ibfind(). Same as setting the XEOS bit in a ibeos() call.	interface or device	optional
timeout	Sets the io timeout for a board or device descriptor opened through ibfind(). The possible settings are the same as the constants used by ibtmo().	interface or device	optional

gpib_config

Name

`gpib_config` — GPIB administration program

Synopsis

gpib_config [--minor *`number`*]

gpib_config [--board-type *`board_type`*] [--dma *`number`*] [--file *`file_path`*] [--iobase *`number`*] [--ifc] [--no-ifc] [--irq *`number`*] [--minor *`number`*] [--pad *`number`*] [--pci-bus *`number`*] [--pci-slot *`number`*] [--sad *`number`*] [--sre] [--no-sre] [--system-controller] [--no-system-controller]

Description

gpib_config must be run after the kernel driver module for a GPIB interface board is loaded. It performs configuration of driver settings that cannot be performed by libgpib at runtime. This includes configuration which requires root privilege (for example, setting the base address or irq of a board), and

configuration which should only be performed once and not automatically redone every time a program using libgpib is run (for example, setting the board's GPIB address).

The board to be configured by gpib_config is selected by the `--minor` option. By default, the board settings are read from the gpib.conf configuration file. However, individual settings can be overiden by use of command-line options (see below).

Options

`-b, --iobase` *`number`*

Set io base address to *`number`* for boards without plug-and-play cabability.

`-d, --dma` *`number`*

Specify isa dma channel *`number`* for boards without plug-and-play cabability.

`-I, --init-data` *`file_path`*

Upload binary initialization data (firmware) from *`file_path`* to board.

`-i, --irq` *`number`*

Specify irq line *`number`* for boards without plug-and-play cabability.

`-f, --file` *`file_path`*

Specify file path for configuration file. The values in the configuration file will be used as defaults for unspecified options. The default configuration file is "/etc/gpib.conf".

`-h, --help`

Print help on options and exit.

`-l, --pci-slot` *`number`*

Specify pci slot *`number`* to select a specific pci board. If used, you must also specify the pci bus with `--pci-bus`.

`-m, --minor` *`number`*

Configure gpib device file with minor number *`number`* (default is 0).

`-p, --pad` *`number`*

Specify primary gpib address. *`number`* should be in the range 0 through 30.

`-s, --sad` *`number`*

Specify secondary gpib address. *`number`* should be 0 (disabled) or in the range 96 through 126 (0x60 through 0x7e hexadecimal).

`-t, --board-type` *`board_type`*

Set board type to *`board_type`*.

`-u, --pci-bus` *`number`*

Specify pci bus *`number`* to select a specific pci board. If used, you must also specify the pci slot with `--pci-slot`.

`--[no-]ifc`

Perform (or not) interface clear after bringing board online. Default is `--ifc`.

`--[no-]sre`

Assert (or not) remote enable line after bringing board online. Default is `--sre`.

`--[no-]system-controller`

Configure board as system controller (or not).

3. Supported Hardware

3.1. Supported Hardware Matrix

Table 2. Linux-GPIB Supported Hardware Matrix

make	model	kernel driver module	board_type (for /etc/gpib.conf)
Agilent (HP)	82341C	hp_82341.ko	hp_82341
Agilent (HP)	82341D	hp_82341.ko	hp_82341
Agilent	82350B	agilent_82350b.ko	agilent_82350b
Agilent	82357A	agilent_82357a.ko	agilent_82357a
Capital Equipment Corporation	PC-488	pc2_gpib.ko	pcII
Capital Equipment Corporation	PCI-488	cec_gpib.ko	cec_pci
CONTEC	GP-IB(PC)	pc2_gpib.ko	pcIIa
Hameg	HO80	pc2_gpib.ko	pcII
Hameg	HO80-2	ines_gpib.ko	ines_isa
Hewlett Packard	HP82335	hp82335.ko	hp82335
Hewlett Packard	HP27209	hp82335.ko	hp82335
Ines	GPIB-HS-NT	ines_gpib.ko	ines_isa
Ines	GPIB for Compact PCI	ines_gpib.ko	ines_pci, ines_pci_unaccel
Ines	GPIB for PCI	ines_gpib.ko	ines_pci, ines_pci_unaccel
Ines	GPIB for PCMCIA	ines_gpib.ko	ines_pcmcia, ines_pcmcia_unaccel
Ines	GPIB PC/104	ines_gpib.ko	ines_isa
Iotech	GP488B	pc2_gpib.ko	pcIIa
Keithley	KPCI-488	cec_gpib.ko	cec_pci
Keithley	MBC-488	pc2_gpib.ko	pcII
Measurement Computing (Computer Boards)	CPCI-GPIB	cb7210.ko	cbi_pci, cbi_pci_unaccel
Measurement Computing (Computer Boards)	ISA-GPIB	cb7210.ko	cbi_isa, cbi_isa_unaccel

make	model	kernel driver module	board_type (for /etc/gpib.conf)
Measurement Computing (Computer Boards)	ISA-GPIB/LC	cb7210.ko	cbi_isa_unaccel
Measurement Computing (Computer Boards)	ISA-GPIB-PC2A	pc2_gpib.ko	pcIIa (nec7210 chip), pcIIa_cb7210 (cb7210 chip)
Measurement Computing (Computer Boards)	PCI-GPIB/1M	cb7210.ko	cbi_pci, cbi_pci_unaccel
Measurement Computing (Computer Boards)	PCI-GPIB/300K	cb7210.ko	cbi_pci_unaccel
Measurement Computing (Computer Boards)	PCMCIA-GPIB	cb7210.ko	cbi_pcmcia, cbi_pcmcia_unaccel
National Instruments	AT-GPIB (with NAT4882 chip)	tnt4882.ko	ni_nat4882_isa, ni_nat4882_isa_accel
National Instruments	AT-GPIB (with NEC7210 chip)	tnt4882.ko	ni_nec_isa, ni_nec_isa_accel
National Instruments	AT-GPIB/TNT	tnt4882.ko	ni_isa, ni_isa_accel
National Instruments	GPIB-USB-B	ni_usb_gpib.ko	ni_usb_b
National Instruments	GPIB-USB-HS	ni_usb_gpib.ko	ni_usb_b
National Instruments	PCI-GPIB	tnt4882.ko	ni_pci
National Instruments	PCI-GPIB+	tnt4882.ko	ni_pci
National Instruments	PCM-GPIB	tnt4882.ko	ni_pci
National Instruments	PXI-GPIB	tnt4882.ko	ni_pci
National Instruments	PCII	pc2_gpib.ko	pcII
National Instruments	PCIIa	pc2_gpib.ko	pcIIa
National Instruments	PCII/IIa	pc2_gpib.ko	pcII or pcII_IIa (depending on board switch)
National Instruments	PCMCIA-GPIB	tnt4882.ko	ni_pcmcia, ni_pcmcia_accel
Quancom	PCIGPIB-1	ines_gpib.ko	ines_pci or ines_pci_unaccel (Ines iGPIB 72010 chip), cbi_pci_unaccel (Measurement Computing cb7210 chip)

3.2. Board-Specific Notes

3.2.1. Agilent (HP) 82341

After power-up, the Agilent 82341 boards require a firmware upload before they can be used. This can be accomplished using the "--init-data" option of gpib_config. The firmware data can be found in the gpib_firmware tarball available from the Linux-GPIB home page (http://linux-gpib.sourceforge.net/). Note the C and D versions use different firmware data.

If you specify a non-zero base address in /etc/gpib.conf, the driver will assume you are trying to configure a 82341C. Otherwise, the driver will use the kernel's ISAPNP support to attempt to configure an 82341D.

The 82341 does not support detection of an end-of-string character in hardware, it only automatically detects the when the EOI line is asserted. Thus if you use the REOS flag for a read, the board's fifos will not be used for the transfer. This will greatly reduce the maximum transfer rate for your board (which may or may not be noticeable depending on the device you are talking to).

3.2.2. Agilent 82350B

The Agilent 82350B does not support detection of an end-of-string character in hardware, it only automatically detects the when the EOI line is asserted. Thus if you use the REOS flag for a read, the board's fifos will not be used for the transfer. This will greatly reduce the maximum transfer rate for your board (which may or may not be noticeable depending on the device you are talking to).

3.2.3. Agilent 82357A

The Agilent 82357A requires a firmware upload (before gpib_config is run) to become functional after being plugged in. The linux-gpib tarball contains hotplug scripts for automatically running the fxload program to upload the firmware (and to run gpib_config after the firmware is uploaded). However, the actual firmware data itself must be obtained seperately, as part of the gpib_firmware tarball available from the Linux-GPIB home page (http://linux-gpib.sourceforge.net/).

The 82357A has a few limitations due to its firmware code:

- It cannot be run as a device, it must be the system controller.
- It cannot be assigned a secondary address.
- It cannot do 7 bit compares when looking for an end-of-string character (it always compares all 8 bits).

3.2.4. National Instruments GPIB-USB-B

The USB-B requires a firmware upload (before gpib_config is run) to become functional after being plugged in. The linux-gpib tarball contains hotplug scripts for automatically running the fxload program to upload the firmware (and to run gpib_config after the firmware is uploaded). However, the actual firmware data itself must be obtained seperately, as part of the gpib_firmware tarball available from the Linux-GPIB home page (http://linux-gpib.sourceforge.net/).

3.2.5. National Instruments GPIB-USB-HS

Unlike the USB-B, the USB-HS does not require a firmware upload to become functional after being plugged in. The linux-gpib tarball contains hotplug scripts which will automatically run gpib_config after the device is plugged in.

4. Linux-GPIB Reference

Reference for libgpib functions, macros, and constants.

4.1. Global Variables

ibcnt and ibcntl

Name

`ibcnt and ibcntl` — hold number of bytes transferred, or errno

Synopsis

```
#include <gpib/ib.h>

volatile int ibcnt;
volatile long ibcntl;
```

Description

ibcnt and ibcntl are set after IO operations to the the the number of bytes sent or received. They are also set to the value of errno after EDVR or EFSO errors.

If you wish to avoid using a global variable, you may instead use ThreadIbcnt() or ThreadIbcntl() which return thread-specific values.

iberr

Name

`iberr` — holds error code

Synopsis

```
#include <gpib/ib.h>

volatile int iberr;
```

Description

iberr is set whenever a function from the 'traditional' or 'multidevice' API fails with an error. The meaning of each possible value of iberr is summarized in the following table:

Table 1. iberr error codes

constant	value	meaning
EDVR	0	A system call has failed. ibcnt/ibcntl will be set to the value of errno.
ECIC	1	Your interface board needs to be controller-in-charge, but is not.
ENOL	2	You have attempted to write data or command bytes, but there are no listeners currently addressed.
EADR	3	The interface board has failed to address itself properly before starting an io operation.
EARG	4	One or more arguments to the function call were invalid.
ESAC	5	The interface board needs to be system controller, but is not.

constant	value	meaning
EABO	6	A read or write of data bytes has been aborted, possibly due to a timeout or reception of a device clear command.
ENEB	7	The GPIB interface board does not exist, its driver is not loaded, or it is not configured properly.
EDMA	8	Not used (DMA error), included for compatibility purposes.
EOIP	10	Function call can not proceed due to an asynchronous IO operation (ibrda(), ibwrta(), or ibcmda()) in progress.
ECAP	11	Incapable of executing function call, due the GPIB board lacking the capability, or the capability being disabled in software.
EFSO	12	File system error. ibcnt/ibcntl will be set to the value of errno.
EBUS	14	An attempt to write command bytes to the bus has timed out.
ESTB	15	One or more serial poll status bytes have been lost. This can occur due to too many status bytes accumulating (through automatic serial polling) without being read.
ESRQ	16	The serial poll request service line is stuck on. This can occur if a physical device on the bus requests service, but its GPIB address has not been opened (via ibdev() for example) by any process. Thus the automatic serial polling routines are unaware of the device’s existence and will never serial poll it.
ETAB	20	This error can be returned by ibevent(), FindLstn(), or FindRQS(). See their descriptions for more information.

If you wish to avoid using a global variable, you may instead use ThreadIberr() which returns a thread-specific value.

ibsta

Name

`ibsta` — holds status

Synopsis

```
#include <gpib/ib.h>

volatile int ibsta;
```

Description

ibsta is set whenever a function from the ’traditional’ or ’multidevice’ API is called. Each of the bits in ibsta has a different meaning, summarized in the following table:

Table 1. ibsta Bits

bit	value (hexadecimal)	meaning	used for board/device

bit	value (hexadecimal)	meaning	used for board/device
DCAS	0x1	DCAS is set when a board receives the device clear command (that is, the SDC or DCL command byte). It is cleared on the next 'traditional' or 'multidevice' function call following ibwait() (with DCAS set in the wait mask), or following a read or write (ibrd(), ibwrt(), Receive(), etc.). The DCAS and DTAS bits will only be set if the event queue is disabled. The event queue may be disabled with ibconfig().	board
DTAS	0x2	DTAS is set when a board has received a device trigger command (that is, the GET command byte). It is cleared on the next 'traditional' or 'multidevice' function call following ibwait() (with DTAS in the wait mask). The DCAS and DTAS bits will only be set if the event queue is disabled. The event queue may be disabled with ibconfig().	board
LACS	0x4	Board is currently addressed as a listener.	board
TACS	0x8	Board is currently addressed as talker.	board
ATN	0x10	The ATN line is asserted.	board

bit	value (hexadecimal)	meaning	used for board/device
CIC	0x20	Board is controller-in-charge, so it is able to set the ATN line.	board
REM	0x40	Board is in ’remote’ state.	board
LOK	0x80	Board is in ’lockout’ state.	board
CMPL	0x100	I/O operation is complete. Useful for determining when an asynchronous io operation (ibrda(), ibwrta(), etc) has completed.	board or device
EVENT	0x200	One or more clear, trigger, or interface clear events have been received, and are available in the event queue (see ibevent()). The EVENT bit will only be set if the event queue is enabled. The event queue may be enabled with ibconfig().	board
SPOLL	0x400	If this bit is enabled (see ibconfig()), it is set when the board is serial polled. The SPOLL bit is cleared when the board requests service (see ibrsv()) or you call ibwait() on the board with SPOLL in the wait mask.	board

bit	value (hexadecimal)	meaning	used for board/device
RQS	0x800	RQS indicates that the device has requested service, and one or more status bytes are available for reading with ibrsp(). RQS will only be set if you have automatic serial polling enabled (see ibconfig()).	device
SRQI	0x1000	SRQI indicates that a device connected to the board is asserting the SRQ line. It is only set if the board is the controller-in-charge. If automatic serial polling is enabled (see ibconfig()), SRQI will generally be cleared, since when a device requests service it will be automatically polled and then unassert SRQ.	board
END	0x2000	END is set if the last io operation ended with the EOI line asserted, and may be set on reception of the end-of-string character. The IbcEndBitIsNormal option of ibconfig() can be used to configure whether or not END should be set on reception of the eos character.	board or device
TIMO	0x4000	TIMO indicates that the last io operation or ibwait() timed out.	board or device

bit	value (hexadecimal)	meaning	used for board/device
ERR	0x8000	ERR is set if the last 'traditional' or 'multidevice' function call failed. The global variable iberr will be set indicate the cause of the error.	board or device

If you wish to avoid using a global variable, you may instead use ThreadIbsta() which returns a thread-specific value.

4.2. 'Traditional' API Functions

ibask

Name

`ibask` — query configuration (board or device)

Synopsis

```
#include <gpib/ib.h>
int ibask(int ud, int option, int *result);
```

Description

Queries various configuration settings associated with the board or device descriptor *`ud`*. The *`option`* argument specifies the particular setting you wish to query. The result of the query is written to the location specified by *`result`*. To change the descriptor's configuration, see ibconfig().

Table 1. ibask options

option	value (hexadecimal)	result of query	used for board/device
IbaPAD	0x1	GPIB primary address	board or device
IbaSAD	0x2	GPIB secondary address (0 for none, 0x60 to 0x7e for secondary addresses 0 to 30)	board or device
IbaTMO	0x3	Timeout setting for io operations (a number from 0 to 17). See ibmto().	board or device
IbaEOT	0x4	Nonzero if EOI is asserted with last byte on writes. See ibeot().	
IbaPPC	0x5	Parallel poll configuration. See ibppc().	board
IbaREADDR	0x6	Useless, included for compatibility only.	device
IbaAUTOPOLL	0x7	Nonzero if automatic serial polling is enabled.	board
IbaCICPROT	0x8	Useless, included for compatibility only.	board
IbaSC	0xa	Nonzero if board is system controller. See ibrsc().	board
IbaSRE	0xb	Nonzero if board autmatically asserts REN line when it becomes the system controller. See ibsre().	board
IbaEOSrd	0xc	Nonzero if termination of reads on reception of the end-of-string character is enabled. See ibeos(), in particular the REOS bit.	board or device
IbaEOSwrt	0xd	Nonzero if EOI is asserted whenever end-of-string character is sent. See ibeos(), in particular the XEOS bit.	board or device

option	value (hexadecimal)	result of query	used for board/device
IbaEOScmp	0xe	Nonzero if all 8 bits are used to match end-of-string character. Zero if only least significant 7 bits are used. See ibeos(), in particular the BIN bit.	board or device
IbaEOSchar	0xf	The end-of-string byte.	board or device
IbaPP2	0x10	Nonzero if in local parallel poll configure mode. Zero if in remote parallel poll configure mode.	board
IbaTIMING	0x11	Number indicating T1 delay. 1 for 2 microseconds, 2 for 500 nanoseconds, 3 for 350 nanoseconds. The values are declared in the header files as the constants T1_DELAY_2000ns, T1_DELAY_500ns, and T1_DELAY_350ns.	board
IbaReadAdjust	0x13	Nonzero if byte pairs are automatically swapped during reads.	board or device
IbaWriteAdjust	0x14	Nonzero if byte pairs are automatically swapped during writes.	board or device
IbaEventQueue	0x15	Nonzero if event queue is enabled.	board
IbaSPollBit	0x16	Nonzero if the use of the SPOLL bit in ibsta is enabled.	board
IbaSendLLO	0x17	Nonzero if devices connected to this board are automatically put into local lockout mode when brought online with ibfind() or ibdev().	board

option	value (hexadecimal)	result of query	used for board/device
IbaSPollTime	0x18	Timeout for serial polls. The value of the result is between 0 and 17, and has the same meaning as in ibtmo().	device
IbaPPollTime	0x18	Timeout for parallel polls. The value of the result is between 0 and 17, and has the same meaning as in ibtmo().	board
IbaEndBitIsNormal	0x1a	Nonzero if END bit of ibsta is set on reception of end-of-string character or EOI. Zero if END bit is only set on EOI.	board or device
IbaUnAddr	0x1b	Nonzero if UNT (untalk) and UNL (unlisten) commands are automatically sent after a completed io operation using this descriptor.	device
IbaHSCableLength	0x1f	Useless, included only for compatibility.	board
IbaIst	0x20	Individual status bit, a.k.a. ’ist’.	board
IbaRsv	0x21	The current status byte this board will use to respond to serial polls.	board
IbaBNA	0x200	Board index (minor number) of interface board which is the controller-in-charge of this device’s GPIB bus.	device
Iba7BitEOS	0x1000	Nonzero if board supports 7 bit EOS comparisons. See ibeos(), in particular the BIN bit. This is a Linux-GPIB extension.	board

Return value

The value of ibsta is returned.

ibbna

Name

`ibbna` — change access board (device)

Synopsis

```
#include <gpib/ib.h>
int ibbna(int ud, const char *name);
```

Description

ibbna() changes the GPIB interface board used to access the device specified by *ud*. Subsequent device level calls using the descriptor *ud* will assume the device is connected to the interface board specified by *name*. If you wish to specify a device's new access board by board index instead of name, you can use the IbcBNA option of ibconfig().

The name of a board can be specified in the configuration file gpib.conf.

On success, iberr is set to the board index of the device's old access board.

Return value

The value of ibsta is returned.

ibcac

Name

ibcac — assert ATN (board)

Synopsis

```
#include <gpib/ib.h>
int ibcac(int ud, int synchronous);
```

Description

ibcac() causes the board specified by the board descriptor *ud* to become active controller by asserting the ATN line. The board must be controller-in-change in order to assert ATN. If *synchronous* is nonzero, then the board will wait for a data byte on the bus to complete its transfer before asserting ATN. If the synchronous attempt times out, or *synchronous* is zero, then ATN will be asserted immediately.

It is generally not necessary to call ibcac(). It is provided for advanced users who want direct, low-level access to the GPIB bus.

Return value

The value of ibsta is returned.

ibclr

Name

ibclr — clear device (device)

Synopsis

```
#include <gpib/ib.h>
int ibclr(int ud);
```

Description

ibclr() sends the clear command to the device specified by *ud*.

Return value

The value of ibsta is returned.

ibcmd

Name

`ibcmd` — write command bytes (board)

Synopsis

```
#include <gpib/ib.h>
int ibcmd(int ud, const void *commands, long num_bytes);
```

Description

ibcmd() writes the command bytes contained in the array *commands* to the bus. The number of bytes written from the array is specified by *num_bytes*. The *ud* argument is a board descriptor, and the board must be controller-in-charge. Most of the possible command bytes are declared as constants in the header files. In particular, the constants GTL, SDC, PPConfig, GET, TCT, LLO, DCL, PPU, SPE, SPD, UNL, UNT,and PPD are available. Additionally, the inline functions MTA(), MLA(), MSA(), and PPE_byte() are available for producing 'my talk address', 'my listen address', 'my secondary address', and 'parallel poll enable' command bytes respectively.

It is generally not necessary to call ibcmd(). It is provided for advanced users who want direct, low-level access to the GPIB bus.

Return value

The value of ibsta is returned.

ibcmda

Name

`ibcmda` — write command bytes asynchronously (board)

Synopsis

```
#include <gpib/ib.h>
int ibcmda(int ud, const void *commands, long num_bytes);
```

Description

ibcmda() is similar to ibcmd() except it operates asynchronously. ibcmda() does not wait for the sending of the command bytes to complete, but rather returns immediately.

While an asynchronous operation is in progress, most library functions will fail with an EOIP error. In order to sucessfully complete an asynchronous operation, you must call ibwait() until the CMPL bit is set ibsta. Asynchronous operations may also be aborted with an ibstop() or ibonl() call.

Return value

The value of ibsta is returned.

ibconfig

Name

`ibconfig` — change configuration (board or device)

Synopsis

```
#include <gpib/ib.h>
int ibconfig(int ud, int option, int setting);
```

Description

Changes various configuration settings associated with the board or device descriptor *ud*. The *option* argument specifies the particular setting you wish to modify. The *setting* argument specifies the option's new configuration. To query the descriptor's configuration, see ibask().

Table 1. ibconfig options

option	value (hexadecimal)	effect	used for board/device
IbcPAD	0x1	Sets GPIB primary address. Same as ibpad()	board or device
IbcSAD	0x2	Sets GPIB secondary address. Same as ibsad()	board or device
IbcTMO	0x3	Sets timeout for io operations. Same as ibmto().	board or device
IbcEOT	0x4	If setting is nonzero, EOI is asserted with last byte on writes. Same as ibeot().	
IbcPPC	0x5	Sets parallel poll configuration. Same as ibppc().	board
IbcREADDR	0x6	Useless, included for compatibility only.	device
IbcAUTOPOLL	0x7	If setting is nonzero then automatic serial polling is enabled.	board
IbcCICPROT	0x8	Useless, included for compatibility only.	board
IbcSC	0xa	If setting is nonzero, board becomes system controller. Same as ibrsc().	board

option	value (hexadecimal)	effect	used for board/device
IbcSRE	0xb	If setting is nonzero then board asserts REN line. Otherwise REN is unasserted. Same as ibsre().	board
IbcEOSrd	0xc	If setting is nonzero then reads are terminated on reception of the end-of-string character. See ibeos(), in particular the REOS bit.	board or device
IbcEOSwrt	0xd	If setting is nonzero then EOI is asserted whenever the end-of-string character is sent. See ibeos(), in particular the XEOS bit.	board or device
IbcEOScmp	0xe	If setting is nonzero then all 8 bits are used to match the end-of-string character. Otherwise only the least significant 7 bits are used. See ibeos(), in particular the BIN bit.	board or device
IbcEOSchar	0xf	Sets the end-of-string byte. See ibeos().	board or device

option	value (hexadecimal)	effect	used for board/device
IbcPP2	0x10	If setting is nonzero then the board is put into local parallel poll configure mode, and will not change its parallel poll configuration in response to receiving 'parallel poll enable' command bytes from the controller-in-charge. Otherwise the board is put in remote parallel poll configure mode. Some older hardware does not support local parallel poll configure mode.	board
IbcTIMING	0x11	Sets the T1 delay. Use setting of 1 for 2 microseconds, 2 for 500 nanoseconds, or 3 for 350 nanoseconds. These values are declared in the header files as the constants T1_DELAY_2000ns, T1_DELAY_500ns, and T1_DELAY_350ns. A 2 microsecond T1 delay is safest, but will limit maximum transfer speeds to a few hundred kilobytes per second.	board
IbcReadAdjust	0x13	If setting is nonzero then byte pairs are automatically swapped during reads. Presently, this feature is unimplemented.	board or device

option	value (hexadecimal)	effect	used for board/device
IbcWriteAdjust	0x14	If setting is nonzero then byte pairs are automatically swapped during writes. Presently, this feature is unimplemented.	board or device
IbcEventQueue	0x15	If setting is nonzero then the event queue is enabled. The event queue is disabled by default.	board
IbcSPollBit	0x16	If the setting is nonzero then the use of the SPOLL bit in ibsta is enabled.	board
IbcSendLLO	0x17	If the setting is nonzero then devices connected to this board are automatically put into local lockout mode when brought online with ibfind() or ibdev().	board
IbcSPollTime	0x18	Sets timeout for serial polls. The setting must be between 0 and 17, which correspond to the same time periods as in ibtmo().	device
IbcPPollTime	0x18	Sets timeout for parallel polls. The setting must be between 0 and 17, which correspond to the same time periods as in ibtmo().	board
IbcEndBitIsNormal	0x1a	If setting is nonzero then the END bit of ibsta is set on reception of the end-of-string character or EOI (default). Otherwise END bit is only set on EOI.	board or device

option	value (hexadecimal)	effect	used for board/device
IbcUnAddr	0x1b	If setting is nonzero then UNT (untalk) and UNL (unlisten) commands are automatically sent after a completed io operation using this descriptor. This option is off by default.	device
IbcHSCableLength	0x1f	Useless, included only for compatibility.	board
IbcIst	0x20	Sets the individual status bit, a.k.a. 'ist'. Same as ibist().	board
IbcRsv	0x21	Sets the current status byte this board will use to respond to serial polls. Same as ibrsv().	board
IbcBNA	0x200	Changes the GPIB interface board used to access a device. The setting specifies the board index of the new access board. This configuration option is similar to ibbna() except the new board is specified by its board index instead of a name.	device

Return value

The value of ibsta is returned.

ibdev

Name

`ibdev` — open a device (device)

Synopsis

```
#include <gpib/ib.h>
int ibdev(int board_index, int pad, int sad, int timeout, int send_eoi, int
eos);
```

Description

ibdev() is used to obtain a device descriptor, which can then be used by other functions in the library. The argument *`board_index`* specifies which GPIB interface board the device is connected to. The *`pad`* and *`sad`* arguments specify the GPIB address of the device to be opened (see ibpad() and ibsad()). The timeout for io operations is specified by *`timeout`* (see ibtmo()). If *`send_eoi`* is nonzero, then the EOI line will be asserted with the last byte sent during writes (see ibeot()). Finally, the *`eos`* argument specifies the end-of-string character and whether or not its reception should terminate reads (see ibeos()).

Return value

If sucessful, returns a (non-negative) device descriptor. On failure, -1 is returned.

ibeos

Name

`ibeos` — set end-of-string mode (board or device)

Synopsis

```
#include <gpib/ib.h>
int ibeos(int ud, int eosmode);
```

Description

ibeos() is used to set the end-of-string character and mode. The least significant 8 bits of *eosmode* specify the eos character. You may also bitwise-or one or more of the following bits to set the eos mode:

Table 1. End-of-String Mode Bits

constant	value (hexadecimal)	meaning
REOS	0x400	Enable termination of reads when eos character is received.
XEOS	0x800	Assert the EOI line whenever the eos character is sent during writes.
BIN	0x1000	Match eos character using all 8 bits (instead of only looking at the 7 least significant bits).

Return value

The value of ibsta is returned.

ibeot

Name

`ibeot` — assert EOI with last data byte (board or device)

Synopsis

```
#include <gpib/ib.h>
int ibeot(int ud, int send_eoi);
```

Description

If *send_eoi* is non-zero, then the EOI line will be asserted with the last byte sent by calls to ibwrt() and related functions.

Return value

The value of ibsta is returned.

ibevent

Name

ibevent — get events from event queue (board)

Synopsis

```
#include <gpib/ib.h>
int ibevent(int ud, short *event);
```

Description

ibevent() is used to obtain the oldest event stored in the event queue of the board specified by the board descriptor *ud*. The EVENT bit of ibsta indicates that the event queue contains 1 or more events. An event may be a clear command, a trigger command, or reception of an interface clear. The type of event is stored in the location specified by *event* and may be set to any of the following values:

Table 1. events

constant	value	description
EventNone	0	The board's event queue is empty
EventDevTrg	1	The board has received a trigger command from the controller-in-charge.

constant	value	description
EventDevClr	2	The board has received a clear command from the controller-in-charge.
EventIFC	3	The board has received an interface clear from the system controller. Note, some models of GPIB interface board lack the ability to report interface clear events.

The event queue is disabled by default. It may be enabled by a call to ibconfig(). Each interface board has a single event queue which is shared across all processes and threads. So, only one process can retrieve any given event from the queue. Also, the queue is of finite size so events may be lost (ibevent() will return an error) if it is neglected too long.

Return value

The value of ibsta is returned.

ibfind

Name

`ibfind` — open a board or device (board or device)

Synopsis

```
#include <gpib/ib.h>
int ibfind(const char *name);
```

Description

ibfind() returns a board or device descriptor based on the information found in the configuration file. It is not required to use this function, since device descriptors can be obtained with ibdev() and the ’board

index' (minor number in the configuration file) can be used directly as a board descriptor.

Return value

If sucessful, returns a (non-negative) board or device descriptor. On failure, -1 is returned.

ibgts

Name

`ibgts` — release ATN (board)

Synopsis

```
#include <gpib/ib.h>
int ibgts(int ud, int shadow_handshake);
```

Description

ibgts() is the complement of ibcac(), and causes the board specified by the board descriptor *ud* to go to standby by releasing the ATN line. The board must be controller-in-change to change the state of the ATN line. If *shadow_handshake* is nonzero, then the board will handshake any data bytes it receives until it encounters an EOI or end-of-string character, or the ATN line is asserted again. The received data is discarded.

It is generally not necessary to call ibgts(). It is provided for advanced users who want direct, low-level access to the GPIB bus.

Return value

The value of ibsta is returned.

ibist

Name

`ibist` — set individual status bit (board)

Synopsis

```
#include <gpib/ib.h>
int ibist(int ud, int ist);
```

Description

If *`ist`* is nonzero, then the individual status bit of the board specified by the board descriptor *`ud`* is set. If *`ist`* is zero then the individual status bit is cleared. The individual status bit is sent by the board in response to parallel polls.

On success, iberr is set to the previous ist value.

Return value

The value of ibsta is returned.

iblines

Name

`iblines` — monitor bus lines (board)

Synopsis

```
#include <gpib/ib.h>
int iblines(int ud, short *line_status);
```

Description

iblines() is used to obtain the status of the control and handshaking bus lines of the bus. The board used to monitor the bus is specified by the *ud* argument, and the status of the various bus lines are written to the location specified by *line_status*.

Some older chips are not capable of reporting the status of the bus lines, so each line has two corresponding bits in *line_status*. One bit indicates if the board can monitor the line, and the other bit indicates the line's state. The meaning of the *line_status* bits are as follows:

Table 1. line status bits

constant	value	description
ValidDAV	0x1	The BusDAV bit is valid.
ValidNDAC	0x2	The BusNDAC bit is valid.
ValidNRFD	0x4	The BusNRFD bit is valid.
ValidIFC	0x8	The BusIFC bit is valid.
ValidREN	0x10	The BusREN bit is valid.
ValidSRQ	0x20	The BusSRQ bit is valid.
ValidATN	0x40	The BusATN bit is valid.
ValidEOI	0x80	The BusEOI bit is valid.
BusDAV	0x100	Set/cleared if the DAV line is asserted/unasserted.
BusNDAC	0x200	Set/cleared if the NDAC line is asserted/unasserted.
BusNRFD	0x400	Set/cleared if the NRFD line is asserted/unasserted.
BusIFC	0x800	Set/cleared if the IFC line is asserted/unasserted.
BusREN	0x1000	Set/cleared if the REN line is asserted/unasserted.
BusSRQ	0x2000	Set/cleared if the SRQ line is asserted/unasserted.
BusATN	0x4000	Set/cleared if the ATN line is asserted/unasserted.
BusEOI	0x8000	Set/cleared if the EOI line is asserted/unasserted.

Return value

The value of ibsta is returned.

ibln

Name

`ibln` — check if listener is present (board or device)

Synopsis

```
#include <gpib/ib.h>
int ibln(int ud, int pad, int sad, short *found_listener);
```

Description

ibln() checks for the presence of a device, by attempting to address it as a listener. *ud* specifies the GPIB interface board which should check for listeners. If *ud* is a device descriptor, then the device's access board is used.

The GPIB address to check is specified by the *pad* and *sad* arguments. *pad* specifies the primary address, 0 through 30 are valid values. *sad* gives the secondary address, and may be a value from 0x60 through 0x7e (96 through 126), or one of the constants NO_SAD or ALL_SAD. NO_SAD indicates that no secondary addressing is to be used, and ALL_SAD indicates that all secondary addresses should be checked.

If the board finds a listener at the specified GPIB address(es), then the variable specified by the pointer *found_listener* is set to a nonzero value. If no listener is found, the variable is set to zero.

The board must be controller-in-charge to perform this function. Also, it must have the capability to monitor the NDAC bus line (see iblines()).

Return value

The value of ibsta is returned.

ibloc

Name

`ibloc` — go to local mode (board or device)

Synopsis

```
#include <gpib/ib.h>
int ibloc(int ud);
```

Description

Causes the board or device specified by the descriptor *ud* to go to local mode. If *ud* is a board descriptor, and the board is in local lockout, then the function will fail.

Note, if the system controller is asserting the REN line, then devices on the bus will return to remote mode the next time they are addressed by the controller in charge.

Return value

The value of ibsta is returned.

ibonl

Name

`ibonl` — close or reinitialize descriptor (board or device)

Synopsis

```
#include <gpib/ib.h>
int ibonl(int ud, int online);
```

Description

If the *online* is zero, then ibonl() frees the resources associated with the board or device descriptor *ud*. The descriptor cannot be used again after the ibonl() call.

If the *online* is nonzero, then all the settings associated with the descriptor (GPIB address, end-of-string mode, timeout, etc.) are reset to their 'default' values. The 'default' values are the settings the descriptor had when it was first obtained with ibdev() or ibfind().

Return value

The value of ibsta is returned.

ibpad

Name

ibpad — set primary GPIB address (board or device)

Synopsis

```
#include <gpib/ib.h>
int ibpad(int ud, int pad);
```

Description

ibpad() sets the GPIB primary address to *pad* for the device or board specified by the descriptor *ud*. If *ud* is a device descriptor, then the setting is local to the descriptor (it does not affect the behaviour of calls using other descriptors, even if they refer to the same physical device). If *ud* is a board descriptor, then the board's primary address is changed immediately, which is a global change affecting anything (even other processes) using the board. Valid GPIB primary addresses are in the range from 0 to 30.

Return value

The value of ibsta is returned.

ibpct

Name

`ibpct` — pass control (board)

Synopsis

```
#include <gpib/ib.h>
int ibpct(int ud);
```

Description

ibpct() passes control to the device specified by the device descriptor *ud*. The device becomes the new controller-in-charge.

Return value

The value of ibsta is returned.

ibppc

Name

`ibppc` — parallel poll configure (board or device)

Synopsis

```
#include <gpib/ib.h>
int ibppc(int ud, int configuration);
```

Description

Configures the parallel poll response of the device or board specified by *ud*. The *configuration* should either be set to the 'PPD' constant to disable parallel poll responses, or set to the return value of the PPE_byte() inline function to enable and configure the parallel poll response.

After configuring the parallel poll response of devices on a bus, you may use ibrpp() to parallel poll the devices.

Return value

The value of ibsta is returned.

ibrd

Name

ibrd — read data bytes (board or device)

Synopsis

```
#include <gpib/ib.h>
int ibrd(int ud, void *buffer, long num_bytes);
```

Description

ibrd() is used to read data bytes from a device or board. The argument *ud* can be either a device or board descriptor. Up to *num_bytes* bytes are read into the user-supplied array *buffer*. The read may be terminated by a timeout occuring(see ibtmo()), the talker asserting the EOI line, the board receiving the end-of-string character (see ibeos()), receiving a device clear command, or receiving an interface clear.

If *ud* is a device descriptor, then the library automatically handles addressing the device as talker and the interface board as listener before performing the read.

If *ud* is a board descriptor, no addressing is performed and the board must be addressed as a listener by the controller-in-charge.

After the ibrd() call, ibcnt and ibcntl are set to the number of bytes read.

Return value

The value of ibsta is returned.

ibrda

Name

`ibrda` — read data bytes asynchronously (board or device)

Synopsis

```
#include <gpib/ib.h>
int ibrda(int ud, void *buffer, long num_bytes);
```

Description

ibrda() is similar to ibrd() except it operates asynchronously. ibrda() does not wait for the reception of the data bytes to complete, but rather returns immediately.

While an asynchronous operation is in progress, most library functions will fail with an EOIP error. In order to sucessfully complete an asynchronous operation, you must call ibwait() until the CMPL bit is set ibsta. Asynchronous operations may also be aborted with an ibstop() or ibonl() call.

Return value

The value of ibsta is returned.

ibrdf

Name

`ibrdf` — read data bytes to file (board or device)

Synopsis

```
#include <gpib/ib.h>
int ibrdf(int ud, const char *file_path);
```

Description

ibrdf() is similar to ibrd() except that the data bytes read are stored in a file instead of an array in memory. *`file_path`* specifies the save file. If the file already exists, the data will be appended onto the end of the file.

Return value

The value of ibsta is returned.

ibrpp

Name

`ibrpp` — perform a parallel poll (board or device)

Synopsis

```
#include <gpib/ib.h>
int ibrpp(int ud, char *ppoll_result);
```

Description

ibrpp() causes the interface board to perform a parallel poll, and stores the resulting parallel poll byte in the location specified by *ppoll_result*. Bits 0 to 7 of the parallel poll byte correspond to the dio lines 1 to 8, with a 1 indicating the corresponding dio line is asserted. The devices on the bus you wish to poll should be configured beforehand with ibppc(). The board which performs the parallel poll must be controller-in-charge, and is specified by the descriptor *ud*. If *ud* is a device descriptor instead of a board descriptor, the device's access board performs the parallel poll.

Return value

The value of ibsta is returned.

ibrsc

Name

ibrsc — request system control (board)

Synopsis

```
#include <gpib/ib.h>
int ibrsc(int ud, int request_control);
```

Description

If *request_control* is nonzero, then the board specified by the board descriptor *ud* is made system controller. If *request_control* is zero, then the board releases system control.

The system controller has the ability to assert the REN and IFC lines, and is typically also the controller-in-charge. A GPIB bus may not have more than one system controller.

Return value

The value of ibsta is returned.

ibrsp

Name

`ibrsp` — conduct serial poll (device)

Synopsis

```
#include <gpib/ib.h>
int ibrsp(int ud, char *result);
```

Description

ibrsp() serial polls the device specified by *ud*. The status byte is stored in the location specified by *result*.

Return value

The value of ibsta is returned.

ibrsv

Name

`ibrsv` — request service (board)

Synopsis

```
#include <gpib/ib.h>
int ibrsv(int ud, int status_byte);
```

Description

The serial poll response byte of the board specified by the board descriptor *ud* is set to *status_byte*. If the request service bit (0x40 hexadecimal) in *status_byte* is set, then the board will also request service by asserting the RQS line.

Return value

The value of ibsta is returned.

ibsad

Name

ibsad — set secondary GPIB address (board or device)

Synopsis

```
#include <gpib/ib.h>
int ibsad(int ud, int sad);
```

Description

ibsad() sets the GPIB secondary address of the device or board specified by the descriptor *ud*. If *ud* is a device descriptor, then the setting is local to the descriptor (it does not affect the behaviour of calls using other descriptors, even if they refer to the same physical device). If *ud* is a board descriptor, then the board's secondary address is changed immediately, which is a global change affecting anything (even other processes) using the board.

This library follows NI's unfortunate convention of adding 0x60 hexadecimal (96 decimal) to secondary addresses. That is, if you wish to set the secondary address to 3, you should set *sad* to 0x63. Setting *sad* to 0 disables the use of secondary addressing. Valid GPIB secondary addresses are in the range from 0 to 30 (which correspond to *sad* values of 0x60 to 0x7e).

Return value

The value of ibsta is returned.

ibsic

Name

`ibsic` — perform interface clear (board)

Synopsis

```
#include <gpib/ib.h>
int ibsic(int ud);
```

Description

ibsic() resets the GPIB bus by asserting the 'interface clear' (IFC) bus line for a duration of at least 100 microseconds. The board specified by *ud* must be the system controller in order to assert IFC. The interface clear causes all devices to untalk and unlisten, puts them into serial poll disabled state (don't worry, you will still be able to conduct serial polls), and the board becomes controller-in-charge.

Return value

The value of ibsta is returned.

ibsre

Name

`ibsre` — set remote enable (board)

Synopsis

```
#include <gpib/ib.h>
int ibsre(int ud, int enable);
```

Description

If *enable* is nonzero, then the board specified by the board descriptor *ud* asserts the REN line. If *enable* is zero, the REN line is unasserted. The board must be the system controller.

Return value

The value of ibsta is returned.

ibstop

Name

ibstop — abort asynchronous i/o operation (board or device)

Synopsis

```
#include <gpib/ib.h>
int ibstop(int ud);
```

Description

ibstop() aborts an asynchronous i/o operation (for example, one started with ibcmda(), ibrda(), or ibwrta()).

The return value of ibstop() is counter-intuitive. On successfully aborting an asynchronous operation, the ERR bit is set in ibsta, and iberr is set to EABO. If the ERR bit is not set in ibsta, then there was no asynchronous i/o operation in progress. If the function failed, the ERR bit will be set and iberr will be set to some value other than EABO.

Return value

The value of ibsta is returned.

ibtmo

Name

`ibtmo` — adjust io timeout (board or device)

Synopsis

```
#include <gpib/ib.h>
int ibtmo(int ud, int timeout);
```

Description

ibtmo() sets timeout for IO operations performed using the board or device descriptor *`ud`*. The actual amount of time before a timeout occurs may be greater than the period specified, but never less. *`timeout`* is specified by using one of the following constants:

Table 1. Timeout constants

constant	value	timeout
TNONE	0	Never timeout.
T10us	1	10 microseconds
T30us	2	30 microseconds
T100us	3	100 microseconds
T300us	4	300 microseconds
T1ms	5	1 millisecond
T3ms	6	3 milliseconds
T10ms	7	10 milliseconds
T30ms	8	30 milliseconds
T100ms	9	100 milliseconds
T300ms	10	300 milliseconds

constant	value	timeout
T1s	11	1 second
T3s	12	3 seconds
T10s	13	10 seconds
T30s	14	30 seconds
T100s	15	100 seconds
T300s	16	300 seconds
T1000s	17	1000 seconds

Return value

The value of ibsta is returned.

ibtrg

Name

`ibtrg` — trigger device (device)

Synopsis

```
#include <gpib/ib.h>
int ibtrg(int ud);
```

Description

ibtrg() sends a GET (group execute trigger) command byte to the device specified by the device descriptor *ud*.

Return value

The value of ibsta is returned.

ibwait

Name

`ibwait` — wait for event (board or device)

Synopsis

```
#include <gpib/ib.h>
int ibwait(int ud, int status_mask);
```

Description

ibwait() will sleep until one of the conditions specified in *`status_mask`* is true. The meaning of the bits in *`status_mask`* are the same as the bits of the ibsta status variable.

If *`status_mask`* is zero, then ibwait() will return immediately. This is useful if you simply wish to get an updated ibsta.

Return value

The value of ibsta is returned.

ibwrt

Name

`ibwrt` — write data bytes (board or device)

Synopsis

```
#include <gpib/ib.h>
```

```
int ibwrt(int ud, const void *data, long num_bytes);
```

Description

ibwrt() is used to write data bytes to a device or board. The argument *ud* can be either a device or board descriptor. *num_bytes* specifies how many bytes are written from the user-supplied array *data*. EOI may be asserted with the last byte sent or when the end-of-string character is sent (see ibeos() and ibeot()). The write operation may be interrupted by a timeout (see ibtmo()), the board receiving a device clear command, or receiving an interface clear.

If *ud* is a device descriptor, then the library automatically handles addressing the device as listener and the interface board as talker, before sending the data bytes onto the bus.

If *ud* is a board descriptor, the board simply writes the data onto the bus. The controller-in-charge must address the board as talker.

After the ibwrt() call, ibcnt and ibcntl are set to the number of bytes written.

Return value

The value of ibsta is returned.

ibwrta

Name

ibwrta — write data bytes asynchronously (board or device)

Synopsis

```
#include <gpib/ib.h>
int ibwrta(int ud, const void *buffer, long num_bytes);
```

Description

ibwrta() is similar to ibwrt() except it operates asynchronously. ibwrta() does not wait for the sending of the data bytes to complete, but rather returns immediately.

While an asynchronous operation is in progress, most library functions will fail with an EOIP error. In order to sucessfully complete an asynchronous operation, you must call ibwait() and until the CMPL bit is set ibsta. Asynchronous operations may also be aborted with an ibstop() or ibonl() call.

Return value

The value of ibsta is returned.

ibwrtf

Name

`ibwrtf` — write data bytes from file (board or device)

Synopsis

```
#include <gpib/ib.h>
int ibwrtf(int ud, const char *file_path);
```

Description

ibwrtf() is similar to ibwrt() except that the data to be written is taken from a file instead of an array in memory. *`file_path`* specifies the file, which is written byte for byte onto the bus.

Return value

The value of ibsta is returned.

4.3. "Multidevice" API Functions

The "Multidevice" API functions provide similar functionality to the "Traditional" API functions. However, some of the "multidevice" functions can be to be performed on multiple devices simultaneously. For example, SendList() can be used to write a message to multiple devices. Such functions take an array of Addr4882_t as an argument. The end of the array is specified by setting the last element to the constant NOADDR.

AllSPoll

Name

`AllSPoll` — serial poll multiple devices

Synopsis

```
#include <gpib/ib.h>
void AllSPoll(int board_desc, Addr4882_t *addressList, short *resultList);
void AllSpoll(int board_desc, const Addr4882_t *addressList, short
*resultList);
```

Description

AllSPoll() causes the interface board specified by *`board_desc`* to serial poll all the GPIB addresses specified in the *`addressList`* array. The results of the serial polls are stored into *`resultList`*. If you only wish to serial poll a single device, ReadStatusByte() or ibrsp() may be more convenient.

This function may also be invoked with the alternate capitalization 'AllSpoll' for compatibility with NI's library.

DevClear

Name

`DevClear` — clear a device

Synopsis

```
#include <gpib/ib.h>
void DevClear(int board_desc, Addr4882_t address);
```

Description

DevClear() causes the interface board specified by *board_desc* to send the clear command to the GPIB addresses specified by *address*. The results of the serial polls are stored into *resultList*. If you wish to clear multiple devices simultaneously, use DevClearList()

DevClearList

Name

DevClearList — clear multiple devices

Synopsis

```
#include <gpib/ib.h>
void DevClearList(int board_desc, const Addr4882_t addressList[]);
```

Description

DevClear() causes the interface board specified by *board_desc* to send the clear command simultaneously to all the GPIB addresses specified by the *addressList* array. If *addressList* is empty or NULL, then the clear command is sent to all devices on the bus. If you only wish to clear a single device, DevClear() or ibclr() may be slightly more convenient.

EnableLocal

Name

`EnableLocal` — put devices into local mode.

Synopsis

```
#include <gpib/ib.h>
void EnableLocal(int board_desc, const Addr4882_t addressList[]);
```

Description

EnableLocal() addresses all of the devices in the *`addressList`* array as listeners then sends the GTL (go to local) command byte, causing them to enter local mode. This requires that the board is the controller-in-charge. Note that while the REN (remote enable) bus line is asserted, the devices will return to remote mode the next time they are addressed.

If *`addressList`* is empty or NULL, then the REN line is unasserted and all devices enter local mode. The board must be system controller to change the state of the REN line.

EnableRemote

Name

`EnableRemote` — put devices into remote mode.

Synopsis

```
#include <gpib/ib.h>
void EnableRemote(int board_desc, const Addr4882_t addressList[]);
```

Description

EnableRemote() asserts the REN (remote enable) line, and addresses all of the devices in the *addressList* array as listeners (causing them to enter remote mode). The board must be system controller.

FindLstn

Name

FindLstn — find devices

Synopsis

```
#include <gpib/ib.h>
void FindLstn(int board_desc, const Addr4882_t padList[], Addr4882_t
resultList[], int maxNumResults);
```

Description

FindLstn() will check the primary addresses in the *padList* array for devices. The GPIB addresses of all devices found will be stored in the *resultList* array. The *maxNumResults* limits the maximum number of results that will be returned, and is usually set to the number of elements in the *resultList* array. If more than *maxNumResults* devices are found, an ETAB error is returned in iberr. The *padList* should consist of primary addresses only, with no secondary addresses (all possible secondary addresses will be checked as necessary).

Your GPIB board must have the capability to monitor the NDAC bus line in order to use this function (see iblines).

FindRQS

Name

`FindRQS` — find device requesting service and read its status byte

Synopsis

```
#include <gpib/ib.h>
void FindRQS(int board_desc, const Addr4882_t addressList[], short *status);
```

Description

FindRQS will serial poll the GPIB addresses specified in the *`addressList`* array until it finds a device requesting service. The status byte of the device requesting service is stored in the location specified by *`status`*. The *`addressList`* array index of the device requesting service is returned in ibcnt. If no device requesting service is found, an ETAB error is returned in iberr.

PassControl

Name

`PassControl` — make device controller-in-charge

Synopsis

```
#include <gpib/ib.h>
void PassControl(int board_desc, const Addr4882_t address);
```

Description

PassControl() causes the board specified by *`board_desc`* to pass control to the device specified by *`address`*. On success, the device becomes the new controller-in-charge.

PPoll

Name

`PPoll` — parallel poll devices

Synopsis

```
#include <gpib/ib.h>
void PPoll(int board_desc, short *result);
```

Description

PPoll() is similar to the 'traditional' API function ibrpp(). It causes the interface board to perform a parallel poll, and stores the parallel poll byte in the location specified by *`result`*. Bits 0 to 7 of the parallel poll byte correspond to the dio lines 1 to 8, with a 1 indicating the corresponding dio line is asserted. The devices on the bus you wish to poll should be configured beforehand with PPollConfig(). The board must be controller-in-charge to perform a parallel poll.

PPollConfig

Name

`PPollConfig` — configure a device's parallel poll response

Synopsis

```
#include <gpib/ib.h>
void PPollConfig(int board_desc, Addr4882_t address, int dio_line, int
line_sense);
```

Description

PPollConfig() configures the device specified by *address* to respond to parallel polls. The *dio_line* (valid values are 1 through 8) specifies which dio line the device being configured should use to send back its parallel poll response. The *line_sense* argument specifies the polarity of the response. If *line_sense* is nonzero, then the specified dio line will be asserted to indicate that the 'individual status bit' (or 'ist') is 1. If *sense* is zero, then the specified dio line will be asserted when ist is zero.

PPollUnconfig

Name

PPollUnconfig — disable devices' parallel poll response

Synopsis

```
#include <gpib/ib.h>
void PPollUnconfig(int board_desc, const Addr4882_t addressList[]);
```

Description

PPollUnconfig() configures the devices specified by *addressList* to ignore parallel polls.

RcvRespMsg

Name

RcvRespMsg — read data

Synopsis

```
#include <gpib/ib.h>
void RcvRespMsg(int board_desc, void *buffer, long count, int termination);
```

Description

RcvRespMsg() reads data from the bus. A device must have already been addressed as talker (and the board as listener) before calling this function. Addressing may be accomplished with the ReceiveSetup() function.

Up to *`count`* bytes are read into the array specified by *`buffer`*. The *`termination`* argument specifies the 8-bit end-of-string character (which must be a value from 0 to 255) whose reception will terminate a read. *`termination`* can also be set to the 'STOPend' constant, in which case no end-of-string character will be used. Assertion of the EOI line will always end a read.

You may find it simpler to use the slightly higher level function Receive(), since it does not require addressing and reading of data to be performed separately.

ReadStatusByte

Name

`ReadStatusByte` — serial poll a device

Synopsis

```
#include <gpib/ib.h>
void ReadStatusByte(int board_desc, Addr4882_t address, short *result);
```

Description

ReadStatusByte() causes the board specified by the board descriptor *`board_desc`* to serial poll the GPIB address specified by *`address`*. The status byte is stored at the location specified by the *`result`* pointer. If you wish to serial poll multiple devices, it may be slightly more efficient to use AllSPoll(). Serial polls may also be conducted with the 'traditional API' function ibrsp().

Receive

Name

`Receive` — perform receive addressing and read data

Synopsis

```
#include <gpib/ib.h>
void Receive(int board_desc, Addr4882_t address, void *buffer, long count,
int termination);
```

Description

Receive() performs the necessary addressing, then reads data from the device specified by *`address`*. It is equivalent to a ReceiveSetup() call followed by a RcvRespMsg() call.

ReceiveSetup

Name

`ReceiveSetup` — perform receive addressing

Synopsis

```
#include <gpib/ib.h>
void ReceiveSetup(int board_desc, Addr4882_t address);
```

Description

ReceiveSetup() addresses the device specified by *`address`* as talker, and addresses the interface board as listener. A subsequent RcvRespMsg() call will read data from the device.

You may find it simpler to use the slightly higher level function Receive(), since it does not require addressing and reading of data to be performed separately.

ResetSys

Name

`ResetSys` — reset system

Synopsis

```
#include <gpib/ib.h>
void ResetSys(int board_desc, const Addr4882_t addressList[]);
```

Description

ResetSys() has the following effects:

- The remote enable bus line is asserted.
- An interface clear is performed (the interface clear bus line is asserted for at least 100 microseconds).
- The device clear command is sent to all the devices on the bus.
- The *RST message is sent to every device specified in the *`addressList`*.

Send

Name

`Send` — perform send addressing and write data

Synopsis

```
#include <gpib/ib.h>
void Send(int board_desc, Addr4882_t address, const void *data, long count,
int eot_mode);
```

Description

Send() addresses the device specified by *address* as listener, then writes data onto the bus. It is equivalent to a SendList() except it only uses a single GPIB address to specify the listener instead of allowing an array of listeners.

SendCmds

Name

SendCmds — write command bytes onto bus

Synopsis

```
#include <gpib/ib.h>
void SendCmds(int board_desc, const void *cmds, long count);
```

Description

SendCmds() writes *count* command byte onto the the GPIB bus from the array *cmds*.

It is generally not necessary to call SendCmds(). It is provided for advanced users who want direct, low-level access to the GPIB bus.

SendDataBytes

Name

SendDataBytes — write data

Synopsis

```
#include <gpib/ib.h>
void SendDataBytes(int board_desc, const void *data, long count, int
eot_mode);
```

Description

SendDataBytes() writes data to the bus. One or more devices must have already been addressed as listener (and the board as talker) before calling this function. Addressing may be accomplished with the SendSetup() function.

count bytes are written from the array specified by *data*. The *eot_mode* argument specifies how the message should be terminated, and may be any of the following values:

Table 1. eot modes

constant	value	description
NULLend	0	Do not assert EOI or add a newline at the end of the write.
DABend	1	Assert EOI with the last byte of the write.
NLend	2	Append a newline, and assert EOI with the newline at the end of the write.

You may find it simpler to use the slightly higher level functions Send() or SendList(), since they does not require addressing and writing of data to be performed separately.

SendIFC

Name

`SendIFC` — perform interface clear

Synopsis

```
#include <gpib/ib.h>
void SendIFC(int board_desc);
```

Description

SendIFC() resets the GPIB bus by asserting the 'interface clear' (IFC) bus line for a duration of at least 100 microseconds. The board specified by *`board_desc`* must be the system controller in order to assert IFC. The interface clear causes all devices to untalk and unlisten, puts them into serial poll disabled state (don't worry, you will still be able to conduct serial polls), and the board becomes controller-in-charge.

SendList

Name

`SendList` — write data to multiple devices

Synopsis

```
#include <gpib/ib.h>
void SendList(int board_desc, const Addr4882_t addressList[], const void
*data, long count, int eot_mode);
```

Description

SendList() addresses the devices in *`addressList`* as listeners, then writes the contents of the array *`data`* to them. It is equivalent to a SendSetup() call followed by a SendDataBytes() call.

SendLLO

Name

`SendLLO` — put devices into local lockout mode

Synopsis

```
#include <gpib/ib.h>
void SendLLO(int board_desc);
```

Description

SendLLO() asserts the 'remote enable' bus line, then sends the LLO command byte. Any devices currently addressed as listener will be put into RWLS (remote with lockout state), and all other devices will enter LWLS (local with lockout state). Local lockout means the remote/local mode of devices cannot be changed though the devices' front-panel controls. Unasserting the REN line should bring the devices out of lockout state.

The SetRWLS() performs a similar function, except it lets you specifiy which devices you wish to address as listener before sending the LLO command.

SendSetup

Name

`SendSetup` — perform send addressing

Synopsis

```
#include <gpib/ib.h>
void SendSetup(int board_desc, const Addr4882_t addressList[]);
```

Description

SendSetup() addresses the devices in *addressList* as listeners, and addresses the interface board as talker. A subsequent SendDataBytes() call will write data to the devices.

You may find it simpler to use the slightly higher level functions Send() or SendList(), since they does not require addressing and writing of data to be performed separately.

SetRWLS

Name

SetRWLS — put devices into remote with lockout state

Synopsis

```
#include <gpib/ib.h>
void SetRWLS(int board_desc, const Addr4882_t addressList[]);
```

Description

SetRWLS() asserts the 'remote enable' bus line, addresses the devices in the *addressList* array as listeners, then sends the LLO command byte. The devices addressed as listener will be put into RWLS (remote with lockout state), and all other devices will enter LWLS (local with lockout state). Local lockout means the remote/local mode of devices cannot be changed though the devices' front-panel controls. Unasserting the REN line should bring the devices out of the lockout state.

TestSRQ

Name

TestSRQ — query state of SRQ bus line

Synopsis

```
#include <gpib/ib.h>
void TestSRQ(int board_desc, short *result);
```

Description

TestSRQ() checks the state of the SRQ bus line and writes its state to the location specified by *result*. A '1' indicates the SRQ line is asserted, and a '0' indicates the line is not asserted.

Some boards lack the capability to report the status of the SRQ line. In such a case, an ECAP error is returned in iberr.

TestSys

Name

TestSys — perform self-test queries on devices

Synopsis

```
#include <gpib/ib.h>
void TestSys(int board_desc, const Addr4882_t addressList[], short
results[]);
```

Description

TestSys() sends the '*TST?' message to all the devices in the *addressList* array, then reads their responses into the *results* array. This will cause devices that conform to the IEEE 488.2 standard to perform a self-test and respond with a zero on success. A non-zero response indicates an error during the self-test.

The number of devices which responded with nonzero values from their self-tests is returned in ibcnt and ibcntl. If a device fails to respond to the *TST? query, an error will be flagged in ibsta (this is different than NI's documented behaviour which is broken).

Trigger

Name

`Trigger` — trigger a device

Synopsis

```
#include <gpib/ib.h>
void Trigger(int board_desc, Addr4882_t address);
```

Description

Trigger() is equivalent to a TriggerList() call with a single address.

TriggerList

Name

`Trigger` — trigger multiple devices

Synopsis

```
#include <gpib/ib.h>
void TriggerList(int board_desc, Addr4882_t addressList[]);
```

Description

TriggerList() sends a GET (group execute trigger) command byte to all the devices specified in the *`addressList`* array. If no addresses are specified in *`addressList`* then the GET command byte is sent without performing any addressing.

WaitSRQ

Name

`WaitSRQ` — sleep until the SRQ bus line is asserted

Synopsis

```
#include <gpib/ib.h>
void WaitSRQ(int board_desc, short *result);
```

Description

WaitSRQ() sleeps until either the SRQ bus line is asserted, or a timeout (see ibtmo()) occurs. A ’1’ will be written to the location specified by *`result`* if SRQ was asserted, and a ’0’ will be written if the function timed out.

4.4. Utility Functions

GetPAD

Name

`GetPAD` — extract primary address from an Addr4882_t value

Synopsis

```
#include <gpib/ib.h>
static __inline__ unsigned int GetPAD(Addr4882_t address);
```

Description

GetPAD() extracts the primary address packed into the Addr4882_t value *address*.

Return value

The primary GPIB address (from 0 through 30) stored in *address*.

GetSAD

Name

GetSAD — extract secondary address from an Addr4882_t value

Synopsis

```
#include <gpib/ib.h>
static __inline__ unsigned int GetSAD(Addr4882_t address);
```

Description

GetSAD() extracts the secondary address packed into the Addr4882_t value *address*.

Return value

The secondary GPIB address (from 0x60 through 0x7e, or 0 for none) stored in *address*.

MakeAddr

Name

`MakeAddr` — pack primary and secondary address into an Addr4882_t value

Synopsis

```
#include <gpib/ib.h>
static __inline__ Addr4882_t MakeAddr(unsigned int pad, unsigned int sad);
```

Description

MakeAddr() generates an Addr4882_t value that corresponds to the specified primary address *`pad`* and secondary address *`sad`*. It does so by putting *`pad`* into the least significant byte and left shifting *`sad`* up to the next byte.

Examples

```
Addr4882_t addressList[ 5 ];

addressList[ 0 ] = 5 /* primary address 5, no secondary address */
addressList[ 1 ] = MakeAddr(3, 0); /* primary address 3, no secondary address */
addressList[ 2 ] = MakeAddr(7, 0x70); /* primary address 3, secondary address 16 */
addressList[ 3 ] = MakeAddr(20, MSA(9)); /* primary address 20, secondary address 9 */
addressList[ 4 ] = NOADDR;
```

Return value

An Addr4882_t value corresponding to the specified primary and secondary GPIB address.

MLA

Name

`MLA` — generate 'my listen address' command byte

Synopsis

```
#include <gpib/ib.h>
uint8_t MLA(unsigned int address);
```

Description

MLA() returns a 'my listen address' command byte corresponding to the *address* argument. The *address* my be between 0 and 30.

Return value

The appropriate MLA command byte is returned.

MSA

Name

MSA — generate 'my secondary address' command byte

Synopsis

```
#include <gpib/ib.h>
uint8_t MSA(unsigned int address);
```

Description

MSA() returns a 'my secondary address' command byte corresponding to the *address* argument. The *address* my be between 0 and 30. This macro is also useful for mangling secondary addresses from the 'real' values between 0 and 30 to the range 0x60 to 0x7e used by most of the library's functions.

Return value

The appropriate MSA command byte is returned.

MTA

Name

`MTA` — generate ’my talk address’ command byte

Synopsis

```
#include <gpib/ib.h>
uint8_t MTA(unsigned int address);
```

Description

MTA() returns a ’my talk address’ command byte corresponding to the *`address`* argument. The *`address`* my be between 0 and 30.

Return value

The appropriate MTA command byte is returned.

PPE_byte

Name

`PPE_byte` — generate ’parallel poll enable’ command byte

Synopsis

```
#include <gpib/ib.h>
uint8_t PPE_byte(unsigned int dio_line, int sense);
```

Description

PPE_byte() returns a 'parallel poll enable' command byte corresponding to the *dio_line* and *sense* arguments. The *dio_line* (valid values are 1 through 8) specifies which dio line the device being configured should use to send back its parallel poll response. The *sense* argument specifies the polarity of the response. If *sense* is nonzero, then the specified dio line will be asserted to indicate that the 'individual status bit' (or 'ist') is 1. If *sense* is zero, then the specified dio line will be asserted when ist is zero.

Return value

The appropriate PPE command byte is returned.

ThreadIbcnt and ThreadIbcntl

Name

`ThreadIbcnt and ThreadIbcntl` — thread-specific ibcnt and ibcntl values

Synopsis

```
#include <gpib/ib.h>
int ThreadIbcnt(void);
long ThreadIbcntl(void);
```

Description

ThreadIbcnt() and ThreadIbcntl() return thread-local versions of the global variables ibcnt and ibcntl.

Return value

The value of ibcnt or ibcntl corresponding to the last ’traditional’ or ’multidevice’ function called in the current thread is returned.

ThreadIberr

Name

`ThreadIberr` — thread-specific iberr value

Synopsis

```
#include <gpib/ib.h>
int ThreadIberr(void);
```

Description

ThreadIberr() returns a thread-local version of the global variable iberr.

Return value

The value of iberr corresponding to the last ’traditional’ or ’multidevice’ function called by the current thread is returned.

ThreadIbsta

Name

`ThreadIbsta` — thread-specific ibsta value

Synopsis

```
#include <gpib/ib.h>
int ThreadIbsta(void);
```

Description

ThreadIbsta() returns a thread-local version of the global variable ibsta.

Return value

The value of ibsta corresponding to the last ’traditional’ or ’multidevice’ function called by the current thread is returned.

5. GPIB protocol

5.1. GPIB command bytes

The meaning and values of the possible GPIB command bytes are as follows:

Table 12. GPIB command bytes

byte value (hexadecimal)	name	description
0x1	GTL	Go to local
0x4	SDC	Selected device clear
0x5	PPConfig (also ’PPC’ on non-powerpc architectures)	Parallel poll configure
0x8	GET	Group execute trigger
0x9	TCT	Take control
0x11	LLO	Local lockout
0x14	DCL	Device clear
0x15	PPU	Parallel poll unconfigure
0x18	SPE	Serial poll enable

byte value (hexadecimal)	name	description
0x19	SPD	Serial poll disable
0x20 to 0x3e	MLA0 to MLA30	My (primary) listen address 0 to 30
0x3f	UNL	Unlisten
0x40 to 0x5e	MTA0 to MTA30	My (primary) talk address 0 to 30
0x5f	UNT	Untalk
0x60 to 0x6f	MSA0 to MSA15, also PPE	When following a talk or listen address, this is 'my secondary address' 0 to 15. When following a parallel poll configure, this is 'parallel poll enable'. For parallel poll enable, the least significant 3 bits of the command byte specify which DIO line the device should use to send its parallel poll response. The fourth least significant bit (0x8) indicates the 'sense' or polarity the device should use when responding.
0x70 to 0x7d	MSA16 to MSA29, also PPD	When following a talk or listen address, this is 'my secondary address' 16 to 29. When following a parallel poll configure, this is 'parallel poll disable'.
0x7e	MSA30	My secondary address 30

5.2. GPIB bus lines

Physically, the GPIB bus consists of 8 data lines, 3 handshaking lines, and 5 control lines (and 8 ground lines). Brief descriptions of how they are used follow:

Table 13. GPIB bus lines

bus line	description	pin number

bus line	description	pin number
DIO1 through DIO8	Data input/output bits. These 8 lines are used to read and write the 8 bits of a data or command byte that is being sent over the bus.	DIO1 to DIO4 use pins 1 to 4, DIO5 to DIO8 use pins 13 to 16
EOI	End-or-identify. This line is asserted with the last byte of data during a write, to indicate the end of the message. It can also be asserted along with the ATN line to conduct a parallel poll.	5
DAV	Data valid. This is a handshaking line, used to signal that the value being sent with DIO1-DIO8 is valid. During transfers the DIO1-DIO8 lines are set, then the DAV line is asserted after a delay called the 'T1 delay'. The T1 delay lets the data lines settle to stable values before they are read.	6
NRFD	Not ready for data. NRFD is a handshaking line asserted by listeners to indicate they are not ready to receive a new data byte.	7
NDAC	Not data accepted. NDAC is a handshaking line asserted by listeners to indicate they have not yet read the byte contained on the DIO lines.	8
IFC	Interface clear. The system controller can assert this line (it should be asserted for at least 100 microseconds) to reset the bus and make itself controller-in-charge.	9
SRQ	Service request. Devices on the bus can assert this line to request service from the controller-in-charge. The controller can then poll the devices until it finds the device requesting service, and perform whatever action is necessary.	10

bus line	description	pin number
ATN	Attention. ATN is asserted to indicate that the DIO lines contain a command byte (as opposed to a data byte). Also, it is asserted with EOI when conducting parallel polls.	11
REN	Remote enable. Asserted by the system controller, it enables devices to enter remote mode. When REN is asserted, a device will enter remote mode when it is addressed by the controller. When REN is false, all devices will immediately return to local mode.	17

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