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This Technical Note discusses the Sony driver control and status calls that are available on the Macintosh.
Changes since April 1990: Corrected Figure 2, since the Return Physical Drive Icon (`csCode = 21`) returns an error message instead of an icon on the Macintosh Plus.

This Note covers the external (software) interface to the Sony 3.5” floppy disk and Hard Disk 20 driver. It describes all the new calls, including those for Modified Frequency Modulation (MFM) driver versions. This discussion assumes a general understanding of the operation of Macintosh drivers. As all of these calls are not available on all Macintosh models, the following table shows which calls are available on which models:

All	`Read, Write, Kill, Eject, Set Tag Buffer, Drive Status`
128K and later ROMs	`Verify Disk, Format Disk, Track Cache Control, Return Physical Drive Icon`
256K and later ROMS	`Return Media Icon, Return Drive Info`
SuperDrive equipped	`Return Format List`
IIfx only	`Diagnostic Raw Track Dump`

Prime (Read & Write) Calls

Read and write calls to Macintosh drivers are described in general in *Inside Macintosh*, Volume II, The Device Manager, but for completeness, this discussion also includes them. The Device Manager prime routines expect to have the following fields set up in the I/O parameter block:

`ioCompletion`	pointer to a completion routine (asynchronous calls) or `NIL` (synchronous calls)
`ioVRefNum`	drive number (for device calls) or volume reference number (for file system calls)
`ioRefNum`	driver’s reference number (-5 for floppy disks or -2 for Hard Disk 20)
`ioBuffer`	pointer to the location in memory where data is read to or

	written from
`ioReqCount`	number of bytes to read from or write to the disk
`ioPosMode`	tells what the absolute starting point is: beginning, end, or current location (bit 6 is set to 1 to do a read-verify instead of a read)

`ioPosOffset`	offset in bytes relative to the starting point in `ioPosMode`

When you make a call to the Sony driver's prime routine, register `A0` points to this I/O parameter block and register `A1` points to the driver's Device Control Entry (DCE). The Device Manager sets the `ioTrap` field of the parameter block to either $A002 for a read request or $A003 for a write request, so the driver can determine the appropriate action. The Device Manager also sets the `dCtlPosition` field of the driver's DCE to the starting byte offset relative to the beginning of the disk.

You can call the Sony driver either synchronously or asynchronously; however, making an immediate "mode" call to the driver causes it to bomb. The driver begins a read or write request, returns control to the caller (either the user (asynchronous) or the Device Manager (synchronous)), then completes the request asynchronously at the interrupt level. When the request is completed or aborted, the driver returns one of the following result codes:

`noErr`	0	no error
`wPrErr`	-44	diskette is write protected
`paramErr`	-50	some of the requested blocks are past the end of the disk or `ioReqCount` is not an even multiple of 512 bytes
`nsDrvErr`	-56	no such drive number
`noDriveErr`	-64	drive not installed
`offLinErr`	-65	read or write request made to an ejected disk
`noNybErr`	-66	could not find five nibbles in 200 tries (Group Coded Recording (GCR)) or byte timeout (MFM)
`noAdrMkErr`	-67	could not find a valid address mark
`dataVerErr`	-68	read verify compare failed
`badCkSmErr`	-69	address mark checksum was incorrect
`badBtSlpErr`	-70	one of the address mark bit slip nibbles was incorrect (GCR)
`noDtaMkErr`	-71	could not find a data mark header
`badDCkSum`	-72	bad data mark checksum
`badDBtSlp`	-73	one of the data mark bit slip nibbles was incorrect (GCR)
`wrUnderRun`	-74	could not write fast enough to keep up with the IWM
`cantStepErr`	-75	step handshake failed during seek
`tk0BadErr`	-76	track zero detect sensor does not change during a head recalibration
`initIWMErr`	-77	unable to initialize IWM
`twoSideErr`	-78	tried to read a double-sided disk on a single-sided drive
`spdAdjErr`	-79	unable to correctly adjust the drive speed

		(GCR, 400K drives only)
`seekErr`	-80	wrong track number read in a sector's address field
`sectNFErr`	-81	sector number never found on a track

Control Calls

Control calls perform all of the operations not related to reading from or writing to a particular disk associated with this driver. The control opcode is passed to the driver in the `csCode` field of the I/O parameter block (byte 26). Control calls which return information do so by passing it back, starting at the `csParam` field of the I/O parameter block (byte 28). Following is a description of each control operation with any result codes it returns.

Kill I/O (csCode=1)

Kill I/O is called to abort any current I/O request in progress. The Sony driver does not support this control call and always returns a result code of -1.

Verify Disk (csCode=5)

Verify Disk reads every sector from the selected disk to verify that they all have been written correctly. If any sector is found to be bad, it aborts immediately and returns one of the following error codes:

`noErr`	0	no error
`controlErr`	-17	verify failed (Hard Disk 20 only)
`nsDrvErr`	-56	no such drive number
`noDriveErr`	-64	drive not installed
`noNybErr`	-66	various read errors
`badDBtSlp`	-73	bad data bit slip error
`cantStepErr`	-75	step handshake failed during seek
`initIWMErr`	-77	unable to initialize IWM
`pdAdjErr`	-79	unable to correctly adjust disk speed
`verErr`	-84	track failed to verify

Format Disk (csCode=6)

If the selected disk is a floppy disk, Format Disk writes address headers and data fields for every sector on the disk (for GCR disks only) and does a limited verification of the format by checking that the address field of the first sector on each track can be read. If the selected disk is a Hard Disk 20, Format Disk does not do an actual format of the media, but instead initializes the data of each sector to all zeroes. If any error occurs (including write-protected media), Format Disk aborts the formatting and returns an error code.

The `csParam` field is used to specify the type of format to be done on floppy disks only. In pre-SWIM versions of the driver, putting a $0001 at `csParam` creates a single-sided disk, while a non-$0001 value (usually $0002) creates a double-sided disk. In the SWIM and later versions, this value is an index of a list of possible formats for the given hardware and disk combination (see the **Return Format List** (csCode = 6) status call for values).

`noErr`	0	no error
`controlErr`	-17	format failed (Hard Disk 20 only)
`wPrErr`	-44	disk is write-protected
`paramErr`	-50	format type is out of range
`nsDrvErr`	-56	no such drive number
`noDriveErr`	-64	drive not installed
`noNybErr`	-66	various read errors
`badBtSlpErr`	-70	…
`wrUnderRun`	-74	write underrun occurred
`cantStepErr`	-75	step handshake failed during seek
`initIWMErr`	-77	unable to initialize IWM
`spdAdjErr`	-79	unable to correctly adjust disk speed
`fmt1Err`	-82	cannot find sector zero after track format
`fmt2Err`	-83	cannot get enough sync between sectors
`noIndexErr`	-83	timed out waiting for drive's index pulse (MFM only)

Eject Disk (csCode=7)

Eject Disk ejects the disk in the selected drive if that drive supports removable media. Since Hard Disk 20 drives are not removable, if one is ejected, the driver posts a `diskInserted` event so that the operating system remounts the drive.

`noErr`	0	no error
`nsDrvErr`	-56	no such drive number
`noDriveErr`	-64	drive not installed
`cantStepErr`	-75	step handshake failed during seek
`tk0BadErr`	-76	track zero detect does not change during head recalibration
`initIWMErr`	-77	unable to initialize IWM

Set Tag Buffer (csCode=8)

If `csParam` is zero, then no separate tag buffer is used. If `csParam` is non-zero, it is assumed to contain a pointer to a buffer where tag bytes from each block are read into or written from on each prime call. Every time a block is read from the disk, the 12 tag bytes are copied into the file tags buffer at `TagData+2` ($2FC) and then into the user's tag buffer. When a block is written, tag bytes are copied into the file tag buffer from the user's tag buffer, and then written to the disk with the rest of the block. The position of a particular block's tag bytes in the user tag buffer is determined by that block's position relative to the first block read or written on the **current** prime call. The file tags for GCR disks include information that a scavenging utility could use to rebuild a disk if the directory structure were trashed. Figure 1 illustrates the tags. For more detailed information about tag buffers, refer to *Inside Macintosh*, Volume II, The Disk Driver.

0	file number
4	fork type (bit 1=1 if resource fork)
5	file attributes (bit 0=1 if locked)
6	relative file block number
8	disk block number

Figure 1–File Tags

Track Cache Control (csCode=9)

When the track cache is enabled, all of the sectors on the last track accessed during a read request are read into a buffer in RAM. The sectors that were actually requested are also returned in the user's buffer. On future read requests, if the track is the same as the last read track, the sector data is read from the cache instead of the disk. Write requests to the driver are passed directly to the disk, and any of the sectors written that are in the cache are marked invalid. Two bytes are passed at `csParam` to control the cache:

csParam	**csParam+1**
=0: disable the cache	<0: remove the cache
≠0: enable the cache	=0: do not remove or install
	>0: install the cache

When the cache is removed, 680x0 register `D0` contains the previous size of the cache.

`noErr`	0	no error
`memFullErr`	-108	not enough room in heap zone to install track cache

Return Physical Drive Icon (csCode=21)

This call returns a pointer to an icon describing the selected drive's physical location. The supported drive icons are shown in Figure 2. Note that only the icons for a particular machine are included in that version of the driver. The Hard Disk 20 icon is in the drive's ROM, so it is available only when a Hard Disk 20 is connected.

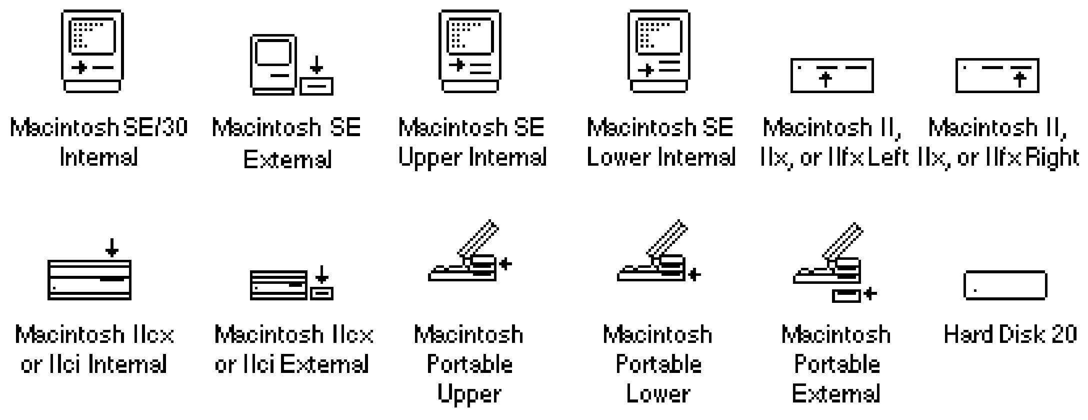

Macintosh SE/30 Internal
Macintosh SE External
Macintosh SE Upper Internal
Macintosh SE Lower Internal
Macintosh II, IIx, or IIfx Left
Macintosh II, IIx, or IIfx Right
Macintosh IIcx or IIci Internal
Macintosh IIcx or IIci External
Macintosh Portable Upper
Macintosh Portable Lower
Macintosh Portable External
Hard Disk 20

Figure 2–Physical Drive Icons

`noErr`	0	no error
`controlErr`	-17	icon does not exist or is not available (Hard Disk 20 only)
`nsDrvErr`	-56	no such drive number
`noDriveErr`	-64	drive not installed

Return Media Icon (csCode=22)

Return Media Icon returns a pointer to an icon for the selected drive's media type. The Sony floppy disk icon is stored in the driver, while the Hard Disk 20 icon is retrieved from the drive's ROM.

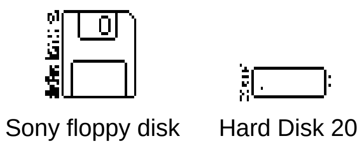


Figure 3–Media Icons

`noErr`	0	no error
`controlErr`	-17	icon does not exist or is not available (Hard Disk 20 only)
`nsDrvErr`	-56	no such drive number
`noDriveErr`	-64	drive not installed

Return Drive Info (csCode=23)

Return Drive Info returns a 32-bit value in `csParam` that describes the location and attributes of the selected drive.

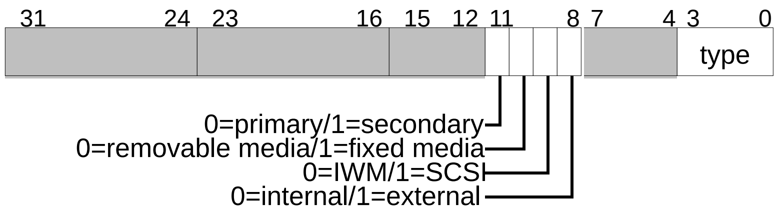


Figure 4–Return Drive Info in csParam

As illustrated in Figure 4, most of the bits of this returned value are currently not used and left open for future expansion. The drive type field occupies bits zero to three and describes the kind of drive that is connected. Currently six different "types" are supported:

0	no such drive
1	unspecified drive
2	400K Sony

3	800K Sony
4	SuperDrive (400K/800K GCR, 720K/1440K MFM)
5	**reserved**
6	**reserved**

7	Hard Disk 20
8-15	**reserved**

The attributes field occupies bits 8 to 11 and describes the location (internal or external, primary or secondary), drive interface (IWM or SCSI), and media type (fixed or removable).

`noErr`	0	no error
`nsDrvErr`	-56	no such drive number
`noDriveErr`	-64	drive not installed

Diagnostic Raw Track Dump (csCode=18244)

This control call reads all or part of a track and returns the raw data it finds so applications can access a floppy disk at a very low level without having to directly access the hardware. This call is available in the ROM of the Macintosh IIfx. An application should check for the presence of this call, and if it's not available, either bail out or find another way to read the raw data. If you make the call and it is not supported on the machine, then it returns with a -17 `controlErr`. This call is needed since the SWIM chip is **not** going to be directly addressable in the future. The following parameters are passed starting at `csParam`:

+0	`clockBitsBuffer` longint pointer to packed bit array (MFM disks only), or `NIL`
+4	`dataBuffer` longint pointer to raw track data, or `NIL`
+8	`byteCount` longint number of bytes requested (dataBuffer must be able to hold this many bytes)
+12	`numDone` longint number of bytes actually read (≤`byteCount`)
+16	`searchMode` word when to start collecting bytes: 0 = as soon as spindle motor is up to speed 1 = after reading an address field 2 = after reading a data field 3 = at the index mark (MFM disks only)
+18	`track` word which track to read (0-79)
+20	`side` byte which side to read (0-1)
+21	`sector` byte which sector to synchronize on (GCR=0-8,9,10,11; MFM=1-9 or 1-18); however, any value from 0-255 is okay

If `clockBitsBuffer` is not `NIL`, it points to a buffer that must be at least one-eighth the size of `dataBuffer`. It consists of an array of bits signifying whether or not the corresponding byte in `dataBuffer` is a mark or data byte. If a bit is equal to one, the byte is an MFM mark byte, but if it is equal to zero, the byte is an MFM data byte. The relationship between bits in `clockBitsBuffer` and `dataBuffer` is shown in Figure 5. The example shows a typical MFM address field.

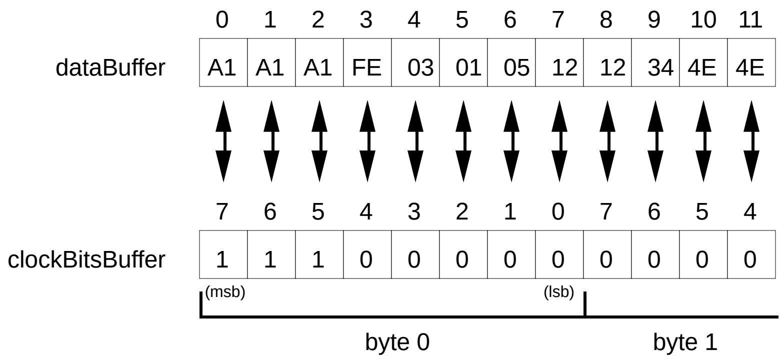


Figure 5–clockBitsBuffer versus dataBuffer

Note: If both `clockBitsBuffer` and `dataBuffer` are `NIL`, the call does nothing. This provides a way for applications to determine if the call exists without first having to allocate large buffers.

Note: The `clockBitsBuffer` has random data in it for GCR disks, but the `dataBuffer` has valid information.

`ByteCount` specifies the number of raw bytes to read. It may not be possible to read that many bytes on every Macintosh due to differences in the way that the hardware and software are implemented, so the call returns the number of bytes that were actually read in `numDone`. If `byteCount` is zero, the call does nothing.

`SearchMode` specifies when to begin actually collecting bytes. The first case (0) implies that the location where reading begins is somewhat random. Cases 1 and 2 begin reading bytes as soon after the end of an address or data field as possible. If the read is done on an MFM disk, the call resynchronizes and begins reading at the next mark byte that follows a sync field. The last case synchronizes with the drive's index signal and then begins reading as soon as it sees a mark byte that follows a sync field.

The `track`, `side`, and `sector` fields are self-explanatory. Of course, the sector number is not needed or used when `searchMode` is either 0 or 3.

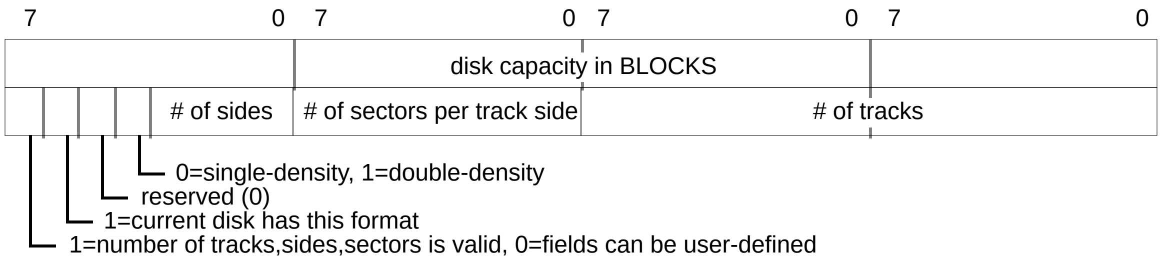
`noErr`	0	no error
`controlErr`	-17	this call is not supported on the host Macintosh
`paramErr`	-50	one or more of the parameters is out of range
`nsDrvErr`	-56	no such drive number
`noDriveErr`	-64	drive not installed
`offLinErr`	-65	read or write request made to an ejected disk
`noNybErr`	-66	could not find five nibbles in 200 tries (GCR) or byte timeout (MFM)
`noAdrMkErr`	-67	could not find a valid address mark
`badCkSmErr`	-69	address mark checksum was incorrect
`badBtSlpErr`	-70	one of the address mark bit slip nibbles was incorrect (GCR)
`noDtaMkErr`	-71	could not find a data mark header
`badDCkSum`	-72	bad data mark checksum
`badDBtSlp`	-73	one of the data mark bit slip nibbles was incorrect (GCR)
`cantStepErr`	-75	step handshake failed during seek
`twoSideErr`	-78	tried to read a double-sided disk on a single-sided drive
`spdAdjErr`	-79	unable to correctly adjust the drive speed (GCR, 400K drives only)
`seekErr`	-80	wrong track number read in a sector's address field
`sectNFErr`	-81	sector number never found on a track
`noIndexErr`	-83	timed out waiting for index signal

Status Calls

The Sony driver currently supports three status calls, which are described in this section. As with the control calls, the status opcode is passed to the driver in the `csCode` field of the I/O parameter block (byte 26). The returned status information is passed back starting at the `csParam` field of the I/O parameter block (byte 28).

Return Format List (csCode=6)

Return Format List is only supported in SWIM or later versions of the Sony driver, whether or not MFM disks are supported. It returns a list of all possible disk formats that are supported with the current combination of disk controller, drive, and media. On entry, `csParam` contains a value specifying the maximum number of formats to return (refer to Technical Note #262, Controlling Status Calls, for more information), and `csParam`+2 contains a pointer to a table which contains the list. On exit, `csParam` contains the number of formats returned (no more than specified) and the table contains the list of formats. If no disk is inserted in the drive, the call returns a `noDriveErr` code. The format information is given in an eight-byte record as shown in Figure 6.



7
0
7
0
7
0
7
0
disk capacity in BLOCKS
# of sides
# of sectors per track side
# of tracks
0=single-density, 1=double-density
reserved (0)
1=current disk has this format
1=number of tracks,sides,sectors is valid, 0=fields can be user-defined

Figure 6–Format Information From Return Format List

If a `track`, `side`, or `sector` field is zero when the TSS valid bit is set to one, that field is considered to be a "don't care" as far as describing the format of the disk. When the TSS valid bit is zero, the `track`, `side`, and `sector` fields may be driver-defined. The formats supported by the driver are as follows:

Format	Capacity in blocks	TSS valid	SD or DD	# of Sides	# of Sectors	# of Tracks
400K GCR	800	yes	SD	1	10[1]	80
800K GCR	1600	yes	SD	2	10[1]	80
720K MFM[2]	1440	yes	SD	2	9	80
1440K MFM[2,3]	2880	yes	DD	2	18	80
Hard Disk 20	38965	no	SD	0	0	0

[1] average number of sectors
[2] requires SWIM and SuperDrive
[3] requires HD media

`noErr`	0	no error
`paramErr`	-50	error in user's parameter list
`nsDrvErr`	-56	no such drive number
`noDriveErr`	-64	drive not installed

Drive Status **(csCode=8)**

Drive Status returns information about a particular drive starting at `csParam`. Drive Status returns only a `noErr` (0) message.

Offset	Name Description
0	current track
2	bit 7 set=write-protected
3	disk-in-place? <0 = disk is being ejected 0 = no disk is currently in the drive 1 = disk was just inserted but no read or write requests have been made for this disk 2 = OS has tried to mount the disk (i.e., read request to driver) 3 = same as 2, except that this is a high-density disk formatted as 400K/800K GCR 8 = same as 2 except for an Hard Disk 20 (8 means it's also non-ejectable)
4	drive installed? –1 = no drive installed 0 = do not know 1 = drive installed
5	number of sides: 0 = single-sided; -1 = double-sided
6	drive queue element: 6 `qLink`: pointer to next queue element 10 `qType`: type of queue (`drvQType`) 12 `dqDrive`: drive number 14 `dqRefNum`: Sony driver's reference number 16 `dqFSID`: file system ID
18	two-sided format?: 0 = current disk has single-sided format -1 = current disk has double-sided format
19	new interface: 0 = old drive interface (400K) -1 = new interface (800K and later)
20	soft error count (2 bytes)

Further Reference:

- *Inside Macintosh*, Volumes II, IV & V, The Disk Driver
- Technical Note M.DV.HLControlAndStatus —
  Controlling Status Calls.