Hercules Fixed Block Architecture Emulation Reference Manual

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Notices

Emulated Devices

The following fixed block architecture devices are emulated by Hercules. The second row identifies where this information is used in data returned by specific commands. “Sense” refers to the Sense ID command. “Char” refers to the Read Device Characteristics command.

Device ID	***Model ID***	***ID Type***	***BPG***	***BPP***	***Blocks***	***Control Unit ID***
Sense [4,5]	Sense [6]	Char [3]	Char [6-9]	Char [10-13]	Char [14-17]	Sense [1,2]
3310	x01	x01	32	352	125,664	x4331
3370-1 3370-A1 3370-B1	x00	x02	62	744	558,000	x3880
3370-2 3370-A2 3370-B2	x04	x05	62	744	712,752	x3880

Device ID	*Model ID*	*ID Type*	*BPG*	*BPP*	*Blocks*	*Control Unit ID*
9332-400	x00	x07	73	292	360,036	x6310
9332-600	x01	x07	73	292	554,800	x6310
9335	x01	x06	71	426	804,714	x6310
9313	x00	x08	96	480	246,240	x6310
9336-10	x00	x11	63	315	920,115	x6310
9336-20 9336-25	x10	x11	111	777	1,672,881	x6310
0671	x00	x12	63	630	574,560	x6310
0671-04	x04	x12	63	630	624,456	x6310
0671-08	x08	x12	63	630	513,072	x6310

Command Chaining

Valid command chaining sequences:

{READ IPL} –> READ IPL [-> LOCATE] -> READ . . .
{READ IPL} -> READ . . .
DEFINE EXTENT -> LOCATE -> WRITE
DEFINE EXTENT -> LOCATE -> READ

Status Indicators

Device and Channel or Subchannel status is presented as 16 bits of information:

- In the Channel Status Word (CSW), stored at real address X'40', or
- in the Sub-Channel Status Word (SCSW), part of the Subchannel Information Block (SCHIB) retrieved by the Store Subchannel instruction.

The following table describes each bit and how in general it relates to FBA devices. Refer to a specific command command concerning details.

CSW Bytes 4,5	***SCSW Bytes 8,9***	***Name***	***Hercules FBA Usage***
		DEVICE STATUS	
32	0	Attention	Possible from Hercules console
33	1	Status Modifier	Not used
34	2	Control Unit End	Not possible for emulated device
35	3	Busy	Possible
36	4	Channel End	Possible
37	5	Device End	Possible
38	6	Unit Check	Possible
39	7	Unit Exception	Not used
		CHANNEL / SUBCHANNEL STATUS	
40	8	Program Controlled Interruption	Triggered by CCW with PCI requested
41	9	Incorrect Length	Set when reading less than the entire physical block(s) or less than the entire length written (possible?)
42	10	Program Check	Caused by program error
43	11	Protection Check	Caused by program error
44	12	Channel-Data Check	Not possible for emulated device
45	13	Channel-Control Check	Not possible for emulated device
46	14	Interface-Control Check	Not possible for emulated device
47	15	Chaining Check	Not possible for emulated device

Channel Commands

x02 – Read Initial Program Load Command

Implicitly defines an extent encompassing the entire FBA volume starting at the first physical block with a file mask inhibiting format writes. Data from the first physical block and only the first physical block is read until either the CCW count is exhausted or the end of the first physical block is reached. Block 1 becomes the current block on completion of the read.

Device Status		***Device Sense***		***Read IPL Command Causes***
Status	***Flags***	***Sense***	***Flags***	
CE,DE	x0C			Normal termination
CE,DE,UC	x0E	CR	x80	READ IPL is command chained from anything other than another READ IPL command.
CE,DE,UC	x0E	OR	x04	Data chaining specified by the CCW.

x03 – Control No-operation Command

No action taken.

Device Status		***Device Sense***		***Control No-op Causes***
Status	***Flags***	***Sense***	***Flags***	
CE,DE	x0C			Normal termination

x04 – Sense Command

Returns 24 bytes of sense data. Hercules only uses the first byte of common sense data for FBA DASD. These are possible settings for bytes 0 and 1 of Hercules returned sense data. The column heading “used” indicates those settings that may be returned by Hercules for FBA DASD. For the cause of a given sense setting flag being set, refer to the command's status and sense table.

Sense Byte 0 Code	***Flag***	***Used***	***Meaning***
CR	x80	yes	Command reject

Sense Byte 0 Code	*Flag*	*Used*	*Meaning*
IR	x40		Intervention required
BOC	x20		Bus out check
EC	x10		Equipment check
DC	x08		Data check
OR	x04	yes	Overrun
US	x04		Unit specify
CC	x02		Control check
OC	x01		Operation check

Sense Byte 1 Code	*Flag*	*Used*	*Meaning*
PER	x80		Permanent error
ITF	x40		Invalid track format
EOC	x20		End of cylinder
MTO	x10		Message to operator
NRF	x08		No record found
FP	x04		File protected
WI	x02		Write inhibited
IE	x01		Imprecise ending

Device Status		*Device Sense*		*Sense Command Causes*
Status	*Flags*	*Sense*	*Flags*	
CE,DE	x0C			Normal termination

x14 – Unconditional Reserve Command

Unconditionally reserves device.

Device Status		*Device Sense*		*Sense Command Causes*
Status	*Flags*	*Sense*	*Flags*	
CE,DE	x0C			Normal termination
CE,DE,UC	x0E	CR	x80	Not first command in the CCW chain

x41 – Write Command

Writes data starting with the current block. If the last block is not completely rewritten it will be filled with X'00'.

Device Status		***Device Sense***		***Write Command Causes***
Status	***Flags***	***Sense***	***Flags***	
CE,DE	x0C			Normal termination
CE,DE,UC	x0E	CR	x80	1. Command chained from anything other than a Locate command. 2. Locate command did not specify a write or write verify operation 3. Attempt to write outside of the volume.
CE,DE,UC	x0E	OR	x04	Attempt to data chain within the physical block.

x42 – Read Command

Reads data starting with the current block.

Device Status		***Device Sense***		***Read Command Causes***
Status	***Flags***	***Sense***	***Flags***	
CE,DE	x0C			Normal termination
CE,DE,UC	x0E	CR	x80	1. Command chained from anything other than a Read or Read IPL command. 2. Locate Command did not specify a READ or READ REPLICATE operation 3. Reading from outside of the volume
CE,DE,UC	x0E	OR	x04	Data chaining within a physical block.

x43 – Locate Command

Positions the DASD for reading or writing within the defined extent. 8 bytes of data as defined in the following table is sent to the device. The Locate and Define Extent commands cooperate to identify the physical block or blocks that will be read or written to the FBA DASD. The relationship between the commands

assumes that a dataset is composed of multiple extents accessed by multi-physical block reads and writes from and to an extent. The Locate and Define Extent commands provide the linkage between:

- logical block addressing relative to the start of the dataset and
- physical block numbering relative to the start of the physical device.

A simple matrix illustrates these relationships. The field names used in the matrix are those used by Hercules FBADEV structure.

FBA I/O Component	***Logical Addressing (Dataset Relative)***	***Physical Addressing (Device Relative)***
Locate Command Data	Bytes 4-7, fbacblk	
Define Extent Command Data	Bytes 8-11, fbaxfirst Bytes 12-15, fbaxlast	Bytes 4-7, fbaxblk
Device Volume		Volume size, fbanumblk

The following computation is performed by the device to locate the physical blocks targeted by the next read or write command.

Field	***Constraint***	
fbalcblk	Identified blocks must be valid for the defined extent	Starting logical block within the dataset to be read or written
- fbaxfirst	Extent must be contained on the device	Logical address of start of the defined extent
result		Number of blocks into the extent that the identified blocks exist
+fbaxblkn		Physical start of the defined extent
result		Starting physical block to be read or written

In the following example, three physical blocks are targeted for reading or writing. These blocks are 1002 through 1004 inclusive of the dataset. The dataset is a multi-extent dataset and this particular extent resides on physical blocks 201 through 206 of the device. The preceding 1000 blocks of the dataset are in other extents. This tables shows the values that are required in the define extent and locate commands for this situation.

Defining Command		***Extent***		***Locate***		***Locate***	***Extent***	
logical block of records in a logical dataset				fbacblk 1002		fbalcnum 3		
Extent's relative position within the logical dataset		fbaxfirst 1000					fbaxlast 1005	
Physical start of the extent		fbaxblk 201						
Physical blocks on the device	200	201	202	203	204	205	206	207 fbanumblk

Bytes	***LOCATE Data Field Content***	
0	*Values*	Operation Code
	x01	Write data operation. Invalid if Extent file mask inhibits all writes). Pads with binary zeros to the end of the block
	x02	Read replicated data operation.
	x04	Format defective block. Invalid if Extent file mask inhibits format writes.
	x05	Write data and verify operation. Invalid if Extent file mask inhibits all writes.
	x06	Read data operation
1	Replication count. Must not be zero and must be a multiple of Block Count. Ignored if operation is not read replicated data	
2,3	Number of blocks, starting with the block displacement (Source for *fbalcnum* field of Hercules FBADEV structure.) Must be within the range defined by *fbaxfirst* (bytes 8-11) and *fbaxlast* (bytes 12-15) if Define Extent Command data. Block displacement plus number of blocks must not extend beyond end of defined extent.	
4-7	Block displacement of the first block relative to the dataset defined by the operation. (Source for *fbalcblk* field of Hercules FBADEV structure.) Must be within the range defined by *fbaxfirst* (bytes 8-11) and *fbaxlast* (bytes 12-15) if Define Extent Command data.	

Device Status		***Device Sense***		***Locate Command Causes***
Status	***Flags***	***Sense***	***Flags***	
CE,DE	x0C			Normal termination

Device Status		***Device Sense***		***Locate Command Causes***
Status	***Flags***	***Sense***	***Flags***	
CE,DE,UC	x0E	CR	x80	1. CCW count is less than 8 bytes. 2. Command not chained from either a Define Extent or Read IPL command. 3. Operation code defined by data is invalid. 4. Operation defined by data is incompatible with the currently defined extent's file mask. 5. Block count is zero. 6. Blocks are outside of the preceding defined extent. 7. For replication, if replication count is zero or not a multiple of block count.

x63 – Define Extent Command

Defines the extent within the volume and type of operations allowed in this command chain. 16 bytes of data transferred to the device as defined in the following table. See the discussion of the Locate command for details on how the block numbers are used in I/O operations.

Bytes	***Define Extent Data Field Contents***	
0	*Values*	*File Mask*
	`..00 ..00`	Must be zero
	`.... .1..`	Permit diagnostic command *(not supported by Hercules)*
	`.... 1...`	CE field extent *(not supported by Hercules)*
	`00.. ....`	Inhibit format writes
	`10.. ....`	Reserved setting
	`01.. ....`	Inhibit all writes
	`11.. ....`	Allow all writes
1-3	x000000	Reserved
4-7	Block number of the first block of the extent relative to the start of the device (must not be beyond the end of the volume, *fbanumblk).* Source of *fbaxblkn* field of Hercules FBADEV structure.	
8-11	Block number of the first block of the extent relative to the start of the dataset. Source of *fbaxfirst* field of Hercules FBADEV structure.	
12-15	Block number of the last block of the extent relative to the start of the dataset (must not be less than *fbaxfirst* or beyond the end of the device). Source of *fbaxlast* field of Hercules FBADEV structure.	

Device Status		***Device Sense***		***Define Extent Command Causes***
Status	***Flags***	***Sense***	***Flags***	
CE,DE	x0C			Normal termination
CE,DE,UC	x0E	CR	x80	1. CCW count is less than 16 bytes. 2. An extent is already defined for this CCW chain. 3. File mask in the data is invalid. 4. Ending block in the data precedes the starting block. 5. Ending block in the data is beyond the end of the volume.

x64 – Read Device Characteristics Command

Reads 32 bytes of FBA DASD Characteristics Record. See the table of emulated devices at beginning of the manual for some values supplied by this command's data.

Bytes	***Values***	***Meaning***
0	x30	Operation Mode
1	x08	Features
2	x21	Fixed Block Architecture device class
3	See ID Type column	Device type
4,5	512	Block size
6-9	See BPG column	Blocks per Cylinder Group. Hercules uses the Cylinder Group as its cache size. Data is read and written to the file in chunks the size of a single cylinder group.
10-13	See BPP column	Blocks per Access position
14-17	See Blocks column	Blocks under movable heads. Hercules allows FBA devices of non-standard block capacity. This always reflects the actual number of blocks in the emulated device.
18-21	0	Blocks under fixed heads

Bytes	*Values*	*Meaning*
22,23	0	Blocks in alternate area
24,25	0	Blocks in CE+SA area
26,27	0	Cycle periods in milliseconds
28,29	0	Minimum time to change access positions in milliseconds
30,31	0	Maximum to change in milliseconds

Device Status		*Device Sense*		*Read Device Characteristics Command Causes*
Status	*Flags*	*Sense*	*Flags*	
CE,DE	x0C			Normal termination

x94 – Device Release Command

Releases device from a previous DEVICE RESERVE command.

Device Status		*Device Sense*		*Read Device Characteristics Command Causes*
Status	*Flags*	*Sense*	*Flags*	
CE,DE	x0C			Normal termination
CE,DE, UC	x0E	CR	x80	Extent previously defined (that is, an operation has already started).

xA4 – Read and Reset Buffered Log Command

Returns 24-bytes of X'00'. The command is supported by Hercules, but the log itself is not.

Device Status		*Device Sense*		*Read Device Characteristics Command Causes*
Status	*Flags*	*Sense*	*Flags*	
CE,DE	x0C			Normal termination

xB4 – Device Reserve Command

Device reserved. *Inhibits other threads waiting on this device from being woken at termination of CCW chains.*

Device Status		***Device Sense***		***Read Device Characteristics Command Causes***
Status	***Flags***	***Sense***	***Flags***	
CE,DE	x0C			Normal termination
CE,DE, UC	x0E	CR	x80	Extent previously defined (that is, an operation has already started).

xE4 – Sense ID Command

Return basic identification information data for the FBA device. *Extended identification data is not supported by Hercules.*

Bytes	***Values***	***SENSE ID FBA DASD Device Basic Identification Information***
0	x'FF”	Successful Operation
1,2	See ID Type Column	Control Unit Type
3	x'01'	Control Unit Model
4,5	See Device ID column	Device Type
6	See Model ID column	Device Model

Device Status		***Device Sense***		***Read Device Characteristics Command Causes***
Status	***Flags***	***Sense***	***Flags***	
CE,DE	x0C			Normal termination