X3T9.2/87-7

TEXAS INSTRUMENTS

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Mr. William E. Burr
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Dear Bill:

At the X3T9.2 Working Group Meeting in Irvine, 7-9 Jan, some discussion arose about downloading microcode, so that the intelligence of formatter/controllers could be upgraded in the field via software distribution, rather than by ROM changeout. Suggestions for implementing this concept were invited.

Our group in TI has implemented microcode download in our latest systems. It was done by adding provisions to the Write Buffer command of CCS. The details are given in the attached command description, which was worked out by a broad-based effort in our group.

We will make multiple copies of this communication available for distribution to everyone who is interested at the February plenary meeting in Florida. If the committee develops an interest in a standardized approach to downloading microcode, and if this approach finds favor, we offer it as a starting place for standard generation.

With best regards,

Bill Spence

D. W. Spence

cc: John Lohmeyer

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X.X.XX Write Buffer command (3Bh). The standard version of this command (CCS: BCV = 0b; SCSI-2: Mode = 00b) with bytes 2 through 5 all zero writes data to the data buffer in the target. The first four bytes transferred to the formatter are the header as defined in Table 6-48 below and are discarded by the formatter. The remaining bytes up to the Allocation Length minus 4 are placed in the data buffer starting at address 0000h. If the Allocation Length is greater than the maximum allowed by the target, the command is terminated with a CHECK STATUS, ILLEGAL REQUEST sense key and PARAMETER OVERRUN error code.

The vendor-unique version of this command (CCS: BCV = 1b; SCSI-2: Mode = 01b) with bytes 2 through 5 all zero is used to download execution code into the target's execution RAM. [If a Microcode Download option in the Write Buffer command were to become standardized, the reserved Mode 11b would be a good candidate for specifying this option.] One or more 16-byte headers as defined in Table 6-49 below follow the Write Buffer/Download command data block and provide information for control of the download operation.

The first four bytes of each header provide flag information. If any reserved bits of Flags 0, 1, 2, and 3 are other than 0, the command shall terminate with a CHECK STATUS, the download specified by the current header shall not be performed, and no further data shall be accepted. The sense key shall be set to ILLEGAL REQUEST, the error code to INVALID PARAMETER, the MSB of the field pointer shall contain the number of the header which contained the error, and the LSB of the field pointer shall contain the number of the byte which is not zero.

The next four bytes are for execution start address. If the ESV (Execution Start Valid) bit in flag 0 is set to a one, code will branch to this address after it completes the download operation specified by the current header. If this option is selected, then command termination, handling of any following download headers and data, CRC checks, etc. must be performed or initiated by the code downloaded from the initiator.

The next four bytes are the download start address. This address specifies where the download code for the current header will be placed in the target's address space.

Both the execution start address and the download start address must be in the valid range of target addresses. If either address falls outside this range, the command will terminate without performing the download specified by the current header, no further data will be accepted, and CHECK STATUS will be set. Sense data will be the same as that described for a non-zero reserved flag bit above, except that the LSB of the field pointer will point to the LSB of the out-of-range address.

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The last four bytes specify the sum of the number of bytes to be downloaded and the number of CRC bytes (2), which is also the number of bytes following and associated with the current header. The number of bytes specified here cannot be more than will fit in the space from the specified download start address to the end of download space, not counting the two CRC bytes. If the byte count is excessive, the command will terminate without performing the download specified in the current download header, and no further data will be accepted. CHECK STATUS will be set, and the Sense data will be the same as that described for a reserved flag bit above, except that the LSB of the field pointer will point to the LSB of the byte count.

If the LNK (LINK) bit is set in flag byte 0, another header follows after the data specified by the current header.

The last 2 bytes of the block of data following the header contain the CRC for the block. The last byte is the LSB of the CRC. The CRC is generated as follows:

1. CRC = 0 (16 bit)
2. MSB of DATWRD = 00h; LSB of DATWRD = Next Data Byte
3. CRC = CRC [XOR] DATWRD
4. CRC = [Right Circular Shift] CRC
5. Last Data Byte? No = Go to 2.

If the CRC value does not match the value generated by the target, the target must declare a CRC error.

If a CRC error, a SCSI-bus out parity error, or an ATN condition is detected by the target during a download operation, the download operation shall be aborted and the command terminated with CHECK STATUS and the appropriate sense key and error code. Download abort due to a CRC error results in HARDWARE ERROR sense key and BUS OUT ERROR error code. Download abort due to a parity error results in HARDWARE ERROR sense key and BUS OUT ERROR error code. Download abort due to ATN results in COMMAND ABORTED sense key and INITIATOR DETECTED ERROR error code.

NOTE

If for any reason the target terminates the Download command with CHECK STATUS condition, the target shall revert to ROM program code execution (in effect destroying any previously downloaded data).

CAUTION

While it is not necessary for the execution of this command, there may be system conditions which make it a desireable practice for the Initiator to reserve all LUNs of the target for its use prior to issuing this command. These system conditions are (1) the command is a Firmware Download command and there is another potential Initiator on the SCSI bus that may also be accessing the Target (any LUN) or (2) a Read Buffer command is to follow to verify data transfer integrity and there may be intervening commands from another Initiator on the SCSI bus. If the Reserve LUN commands are [illegible] Release LUN commands should be issued to the [illegible] LUN's following successful completion of the Download command or a following Read Buffer command.

Table 6-47 Write Buffer Command Data Block Bit Definition

Bit / Byte	7	6	5	4	3	2	1	0
0	0	0	1	1	1	0	1	1
1	Logical Unit Number			0	0	0	Mode	
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0
6	Byte Transfer Length (MSB)							
7	Byte Transfer Length							
8	Byte Transfer Length (LSB)							
9	0	0	0	0	0	0	0	0

Mode = 00b, Write to data buffer with header and data
Mode = 01b, Download firmware to the Formatter execution RAM under control of the headers defined below
Mode = 10b, Write to data buffer with data only
Mode = 11b, Reserved

Table 6-48 Write Buffer Data Header Bit Definition, Non-extended

Bit Byte	7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0

Table 6-49 Download Code Header Bit Definition

Bit Byte	7	6	5	4	3	2	1	0
0	FLAG0 (bits 2-7 reserved)						LNK	ESV
1	FLAG1 (all bits reserved)							
2	FLAG2 (all bits reserved)							
3	FLAG3 (all bits reserved)							
4	EXECUTION START ADDRESS (MSB)							
5	EXECUTION START ADDRESS							
6	EXECUTION START ADDRESS							
7	EXECUTION START ADDRESS (LSB)							
8	DOWNLOAD START ADDRESS (MSB)							
9	DOWNLOAD START ADDRESS							
A	DOWNLOAD START ADDRESS							
B	DOWNLOAD START ADDRESS (LSB)							
C	DOWNLOAD BYTE COUNT (MSB)							
D	DOWNLOAD BYTE COUNT							
E	DOWNLOAD BYTE COUNT							
F	DOWNLOAD BYTE COUNT (LSB)							