MODEL 100
VIDEO SWITCHER

SERIAL INTERFACE PROTOCOL

Manual Number: A75-087614-00

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WARNING

This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instructions manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

Notification as required by FCC Rules, Section 15.818.

PREFACE

This manual describes the communications protocol system used with the Model 100 Video Switcher Serial Interface option.

How The Manual is Organized

Section 1 provides a General Description of the Serial Interface Protocol and module.

Section 2 is the Protocol Description which describes the protocol functions, the access scheme, and the command/message structure.

Section 3 is a quick reference guide that lists each protocol command in numerical order.

Conventions Used in This Manual

The following items are printed in all capital letters:

- Exact names of controls, lamps, and section titles on the control panel
- Major Headings

The following items are printed in initial capital letters:

- Names of figures, tables, and drawings
- Proper names of assemblies and modules
- Subordinate headings

Related Documents

- Model 100 Serial Interface Option Data Package
  Manual Number A90-087614-00

- Model 100 Video Switcher Installation Guide
  Manual Number A78-087610-00

- Model 100 Video Switcher Operator's Manual
  Manual Number A97-087610-00

- Model 100 Video Switcher System Manual
  Manual Number A90-087610-00

Section 1
GENERAL DESCRIPTION

INTRODUCTION

This section provides a general overview of the Model 100 Video Switcher (Figure 1-1) Serial Interface Protocol option and the Serial Interface module.

SERIAL INTERFACE PROTOCOL

The Serial Interface Protocol enables real-time remote control of all the Model 100 switcher functions, except EDITOR ENABLE pushbutton control. The protocol operates via an editor device such as a video-tape editing computer. From here on, this shall simply be referred to as an editor. Using the serial interface protocol, the editor is able to operate the Model 100 switcher without the control panel.

The Model 100 serial interface protocol is based upon the communications protocol of the SMPTE (Society of Motion Picture and Television Engineers) Recommended Practice 113. In addition, the Model 100 protocol has been derived from the protocol originally developed for the larger Model 300 switcher.

SERIAL INTERFACE MODULE

The Model 100 Serial Interface module consists of a 3-inch by 8-inch printed circuit module that is installed on the Control Processor module in the electronics frame of the switcher. The Serial Interface module operates at RS232C or RS422 communication standards at baud rates from 300 to 76,800 bits per second. Refer to the Model 100 Installation Guide (A90-087610) for module installation and baud rate jumper selection.

Figure 1-2 illustrates the functional diagram of the Serial Interface module installed in the Model 100 system. It should be noted that no handshaking is provided for the Serial Interface module. Thus, the editor must be able to continuously operate in full duplex at the selected baud rate. This is most significant for the editor in that the switcher sends up to 128 contiguous data bytes in response to specific commands.

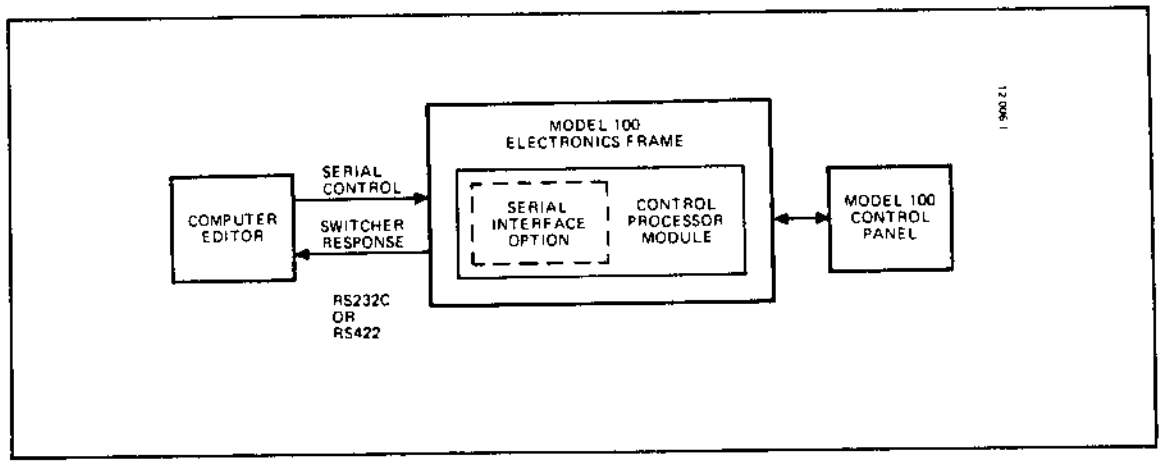


Figure 1-2. Serial Interface Protocol Functional Diagram

Section 2
INSTALLATION

INTRODUCTION

The 100 Serial Interface Protocol provides full duplex communications between the Model 100 switcher and external editor devices. This enables the editor to operate the switcher by remote control. The Serial Interface also enables the entire switcher status to be stored in an "effects memory" register, called the E-MEM register. The E-MEM contents can be read by the editor, stored off-line, and later written back into E-MEM. The E-MEM register contents are then used to set the switcher to a previous configuration.

This section discusses the functional operation and implementation of the protocol.

FUNCTIONAL DESCRIPTION

The 100 Serial Interface Protocol enables real-time remote operation of the Model 100 switcher. When the editor is enabled, it can operate the switcher by completely bypassing, or even in the absence of, the control panel. However, an operator at the control panel can still operate the switcher when the editor is enabled. The following paragraphs highlight the primary functions of the switcher that can be accessed via the protocol interface. Refer to Section 3 for specific details on each protocol command.

Crosspoint Matrix Control

The crosspoint matrix consists of the KEY BUS, PROGRAM BACKGROUND bus, and PRESET BACKGROUND bus. Each bus has ten pushbutton-controlled inputs that are used to select the desired video source. The protocol can read from and write to the matrix. A read operation determines which sources are currently selected, and a write operation selects the desired sources.

Pushbutton/Lamp Control

All the switcher pushbuttons and their associated lamps, except the EDITOR ENABLE pushbutton, can be individually turned on and off. All pushbuttons and lamps can be read by the editor to determine their current state.

Analog Control

Eleven controls on the control panel are knobs that adjust a potentiometer setting. Some of these potentiometers adjust multiple parameters, according to other control panel selections. Two additional controls consist of a joystick (which contains two potentiometers, one for horizontal and one for vertical positioning) and a lever arm. All of these controls produce analog values that range between a defined low value and a high value, as opposed to pushbuttons that produce digital values by either being on or off. The protocol is able to read from and write to the analog controls.

Auto Transition Rate Display

The AUTO TRANSITION RATE display sets the number of frames (0 to 999) for an automatic transition, a Downstream Keyer (DSK) mix, or a Fade to Black (FTB). The protocol can select the type of transition as well as the rate at which it is performed.

E-MEM Control

There are sixteen registers of 112 bytes each that comprise E-MEM. A clarification of the terminology used when referring to data transfers between the editor, E-MEM, and the switcher is shown in Figure 2-1.

The protocol is able to "learn" up to sixteen switcher configurations in E-MEM. The editor can then "recall" an E-MEM register to the switcher to configure it to the stored settings. The "read" command is used by the editor to read an E-MEM register and store its contents off line. The "write" command is used to retrieve the data stored off-line and write it back into E-MEM for later configuration of the switcher.

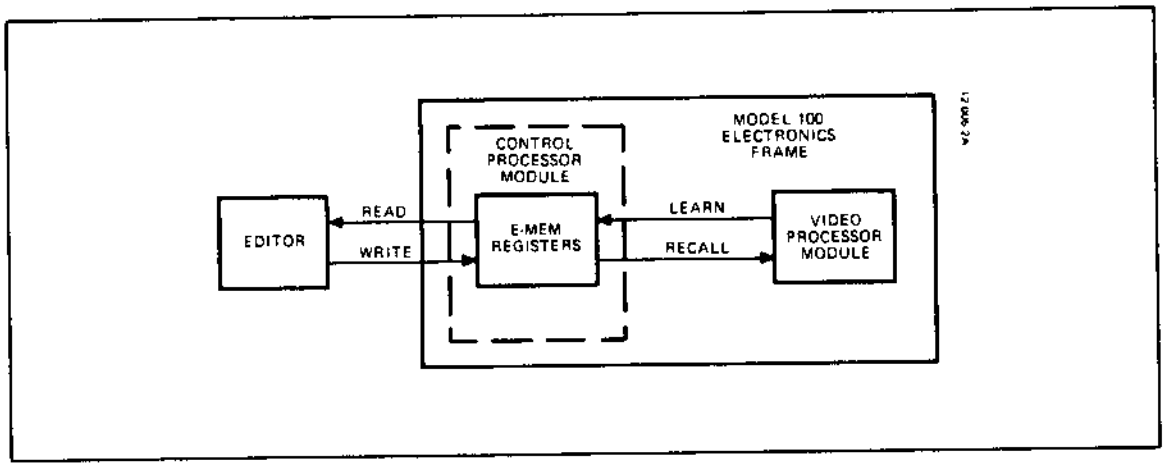


Figure 2-1. Terminology for E-MEM Transfers

PROTOCOL ACCESS

The protocol interface is based upon the SMPTE Recommended Practice 113 (Digital Control Interface System) which establishes guidelines for the orderly flow of data over a serial bus. Figure 2-2 illustrates the major components of the data format.

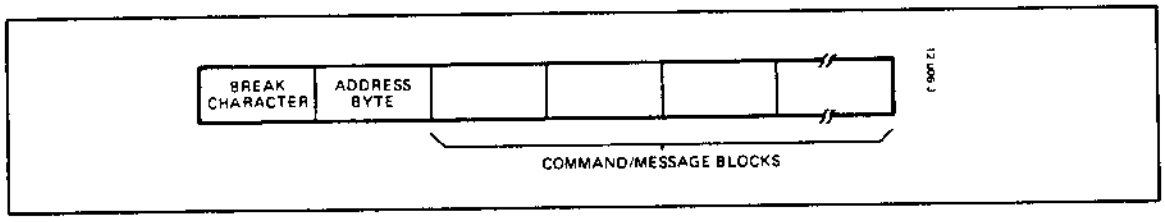


Figure 2-2. Components of Protocol Access

Break Character

The break character is sent by the editor to the serial port of a tributary, or listener, such as the switcher, to prepare it for receipt of further communication. After receipt of the break, the tributary ceases all bus communication, resets any communication errors, and awaits receipt of an address.

Figure 2-3 illustrates the break character. It consists of seventeen to twenty bits of spacing data (logical low or 0) followed by a minimum of two bits of marking data (logical high or 1).

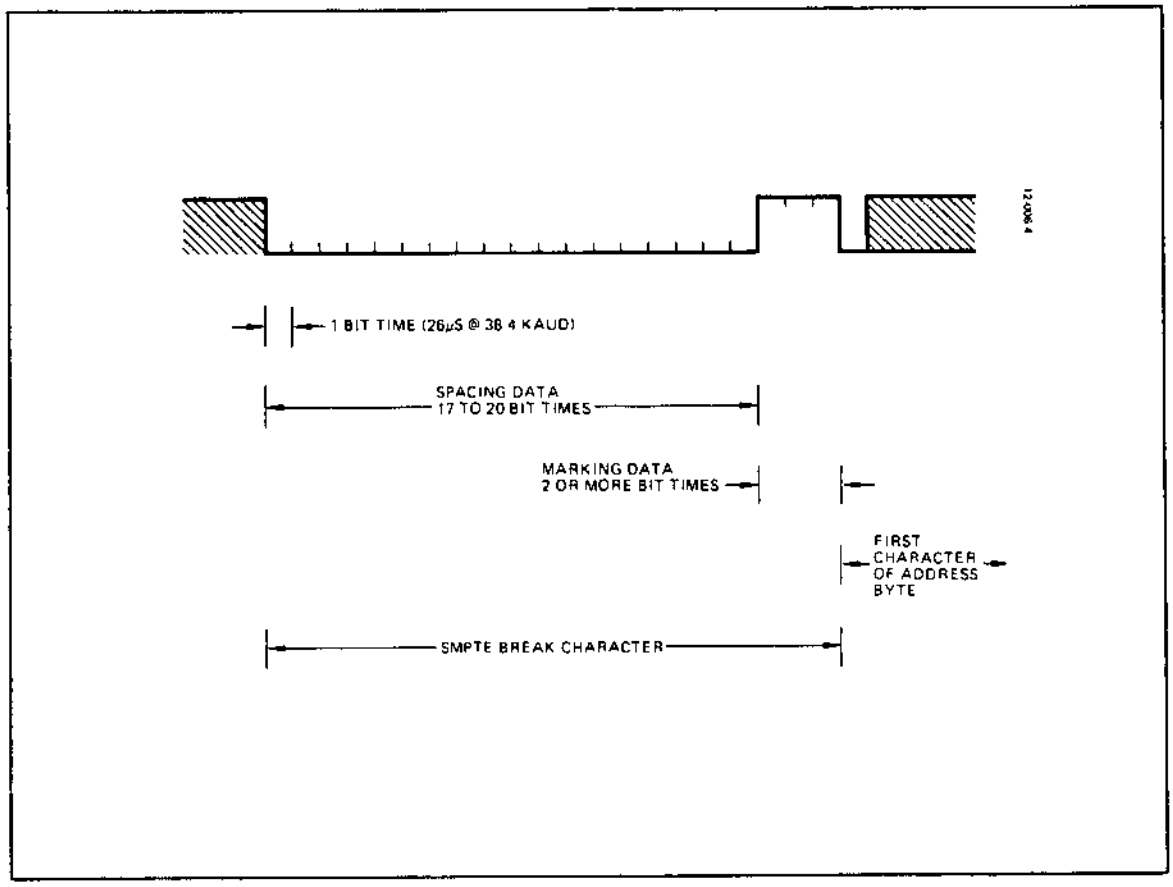


Figure 2-3. SMPTE Break Character

The serial interface has several operating states, as shown in Figure 2-4. The break character advances the serial interface typically from the "idle" state to the "active" state. Note that regardless of which operating state the serial interface is in, receipt of the break sends the interface to the active state.

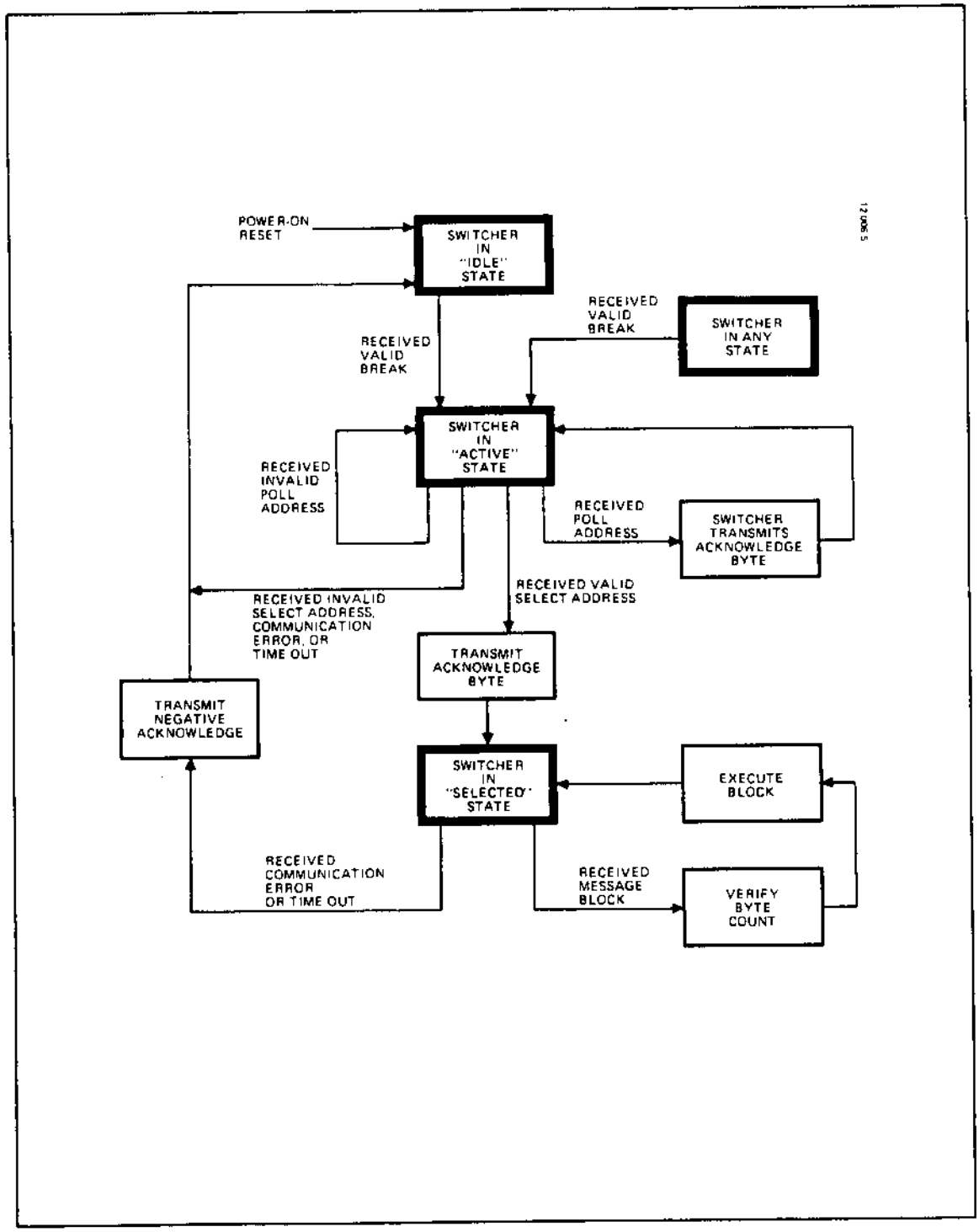


Figure 2-4. Serial Interface State Diagram

Address Byte

After the break has been received, the serial interface will expect a one-byte address, either the Select address or the Poll address. The address will typically be the Select address, which is determined by dipswitch S1 on the Serial Interface module. Dipswitch S2 is included for anticipated future adherence to the 2-byte SMPTE address standard. Figure 2-5 illustrates how to set the dipswitches. Note that the bit numbers do not refer to those labeled on the switches. Bit 7 below refers to the MSB silkscreened on the module and bit 0 to the LSB.

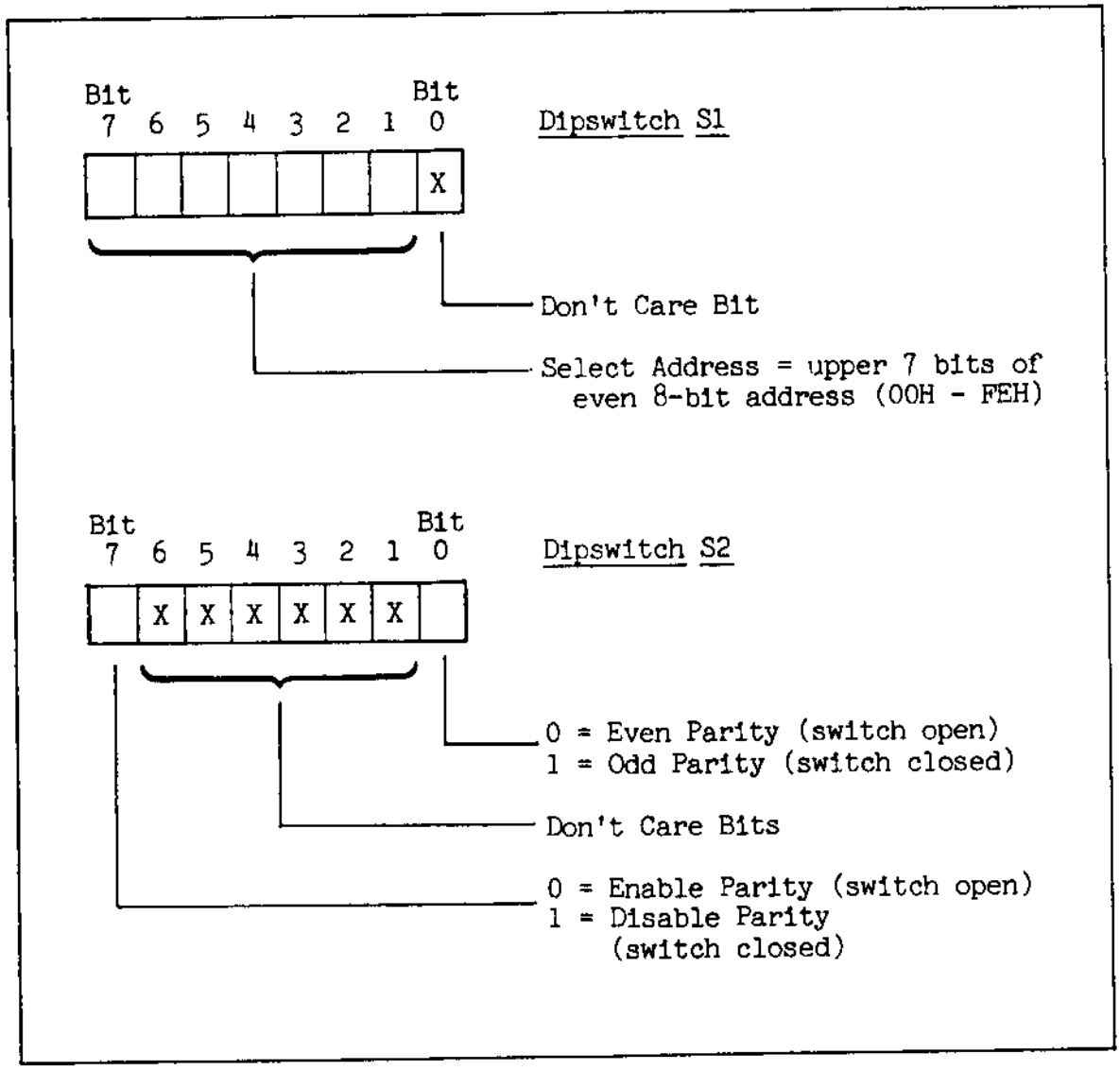


Figure 2-5. Setting the Address Dipswitches

The Select address must be an even number between 00H and FEH. Specifying the Select address automatically specifies the Poll address, which equals the Select address plus one (1). The Poll address is sent by the editor to determine if the tributary is on the bus. If the tributary is present, it would transmit an acknowledge byte of 84H (Hexadecimal) back to the editor and remain in the active state.

The Select address is specific to each tributary. After receipt of the Select address, the serial interface advances to the "selected" state and transmits the 84H acknowledge byte to the controller to indicate successful state transition. The serial interface can now accept command/message block transmissions directing switcher operation. As long as no communication errors occur, the serial interface can receive contiguous command/message blocks without going through the break-address sequence again. A communication error or time out causes the switcher to send a negative acknowledge of 85H, discard any unexecuted commands, and return to the "idle" state.

Note that while in the active state, receipt of any other tributary's Select address or communication error (parity, framing, or data overrun error) causes the serial interface to return to the idle state; necessitating the break-address sequence to resume communication. However, receipt of another tributary's Poll address is ignored and the serial interface remains in the active state.

COMMAND/MESSAGE BLOCK STRUCTURE

In the selected state, the serial interface receives command/message blocks that direct switcher operation. The command/message blocks are structured as shown in Figure 2-6.

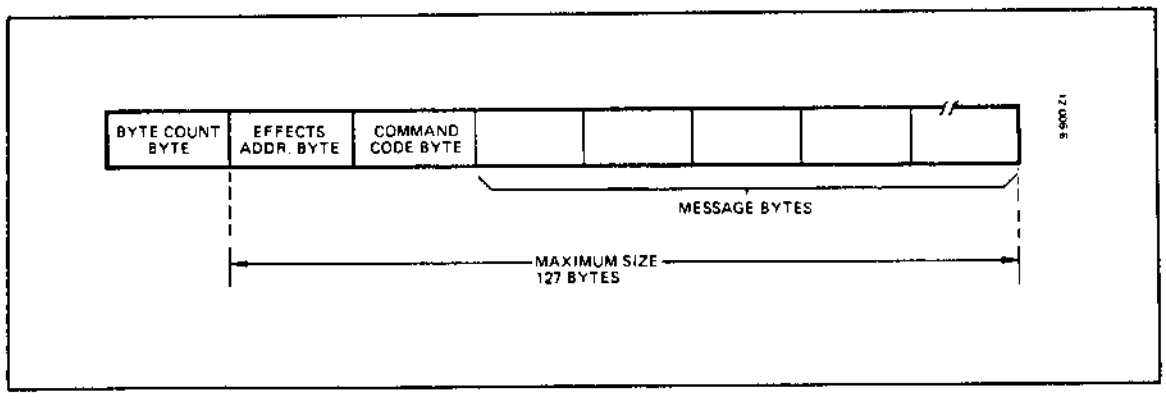


Figure 2-6. Command/Message Block Structure

The serial interface can operate continuously, receiving a contiguous stream of command/message blocks. This enables multiple switcher operations to be performed without constant cycling through the break-address sequence. Command/message blocks received (all bytes) with more than four milliseconds remaining in the current television field will be executed in the following vertical interval. Blocks received after this time may be delayed one additional field.

Byte Count Byte

The command/message blocks can range in size from two to 128 bytes. The first byte of the block contains the byte count. The byte count is the number of the subsequent bytes in the block, thus the valid byte count values are 01H to 7FH (1 to 127). After receiving a valid byte count and the correct number of subsequent bytes, the command is executed.

Effects Address Byte

The effects address byte is typically referred to as EX. It is particularly meaningful in the Model 300 protocol since there are numerous "effects systems" which have a specific EX (effects) address. Since the Model 100 is smaller, the EX byte has only two values. To access any DSK analog controls, EX must be set to 00H. For the analog controls of the effects systems (EFFECTS KEYER, EFFECTS TRANSITION, and PATTERN CONTROL), EX must be set to 01H. For all other controls, EX may be any value.

Command Code Byte

Command codes fall into two broad catagories; read commands and write commands (see Figure 2-7). When the editor issues a read command, the switcher responds by sending the current status of an operational parameter(s) back to the editor. The status information is returned in the format of the write command. Write commands are used by the editor to change an operational parameter(s) of the switcher.

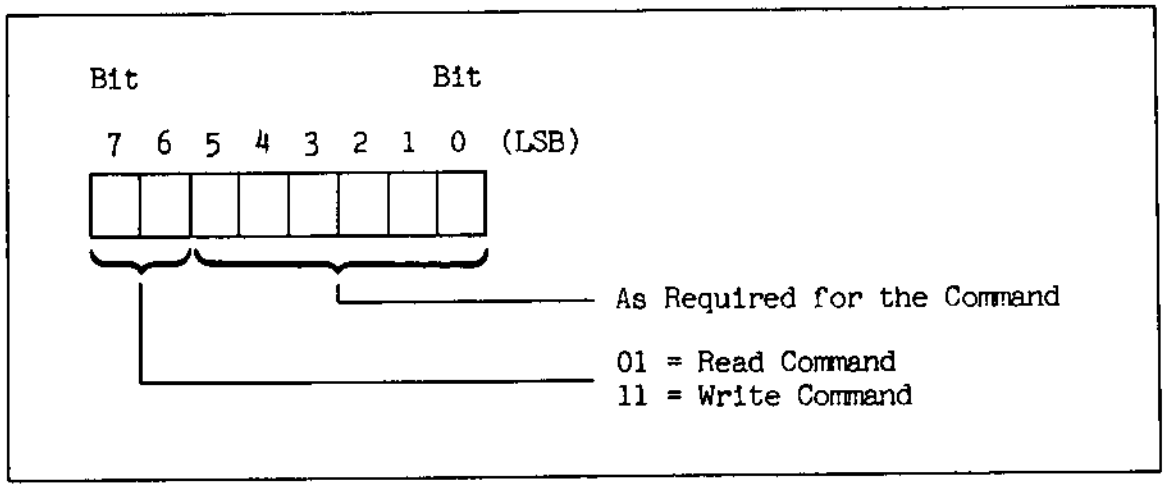


Figure 2-7. Command Byte Structure

Both read and write commands may be sent at any time. When a write command is issued with the EDITOR ENABLE pushbutton on (lamp lit), a 2-byte status message is returned to the editor and the command is executed. With the EDITOR ENABLE off, the write command cannot be executed but the status message is still returned. (The Field Mode command is an exception in that it is executed even when the EDITOR ENABLE is off.) Read commands are always performed, regardless of the EDITOR ENABLE state.

For systems with a Model 100 control panel, the editor cannot change the condition of the EDITOR ENABLE pushbutton, the editor can only read it to determine its status. For systems without the control panel, the editor is always enabled by setting a jumper on the Control Processor module to indicate there is no control panel.

Read Commands

Read commands interrogate the status of the specified operational parameter of the switcher, such as the crosspoint currently selected on the program bus or the setting of the DSK CLIP control.

Read commands may or may not require message bytes following the command code. For example, the command code to read the selected crosspoint on the program bus (41H) does not require any additional data. However, the command code to read an analog control (45H) requires an additional message byte to designate which control to read.

The switcher responds to a read command by transmitting to the editor a command/message block in the format of the write command. By echoing the write command format, responses to a read command can later be sent back to the switcher by the editor to cause execution of that command.

Write Commands

Write commands are sent to the switcher to modify an operational parameter (such as change a crosspoint or set an analog control) or to initiate execution of a function (such as an auto transition). All write commands require at least one byte of message data, which typically specifies the control parameter or setting of the control parameter.

The response to a write command is a two-byte status message. The first byte is the byte count which is 01H. The second byte is the switcher response to the command which is shown in Figure 2-8. The bits that are set to one (1) indicate the status.

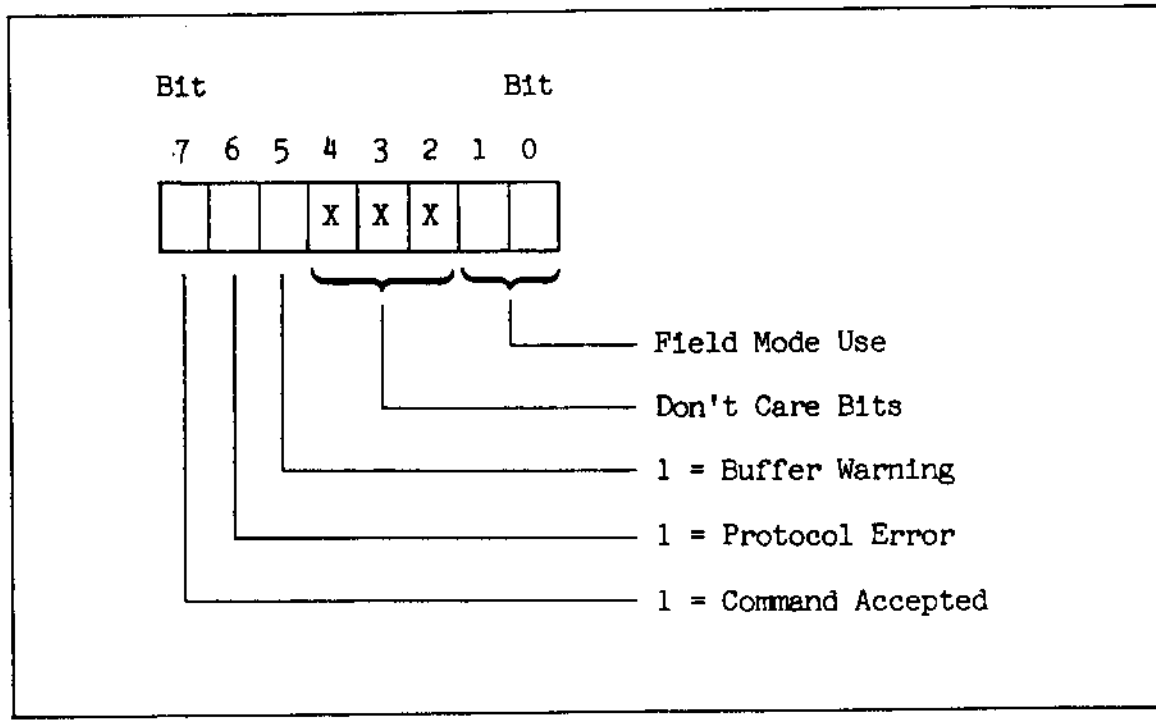


Figure 2-8. Second Byte of Status Message

In the Figure 2-8, bit 7 set to one (1) indicates the command was accepted and execution of it shall occur (if the EDITOR ENABLE is on). Bit 6 set to one indicates an illegal function may have been specified. Bit 5 set to one indicates the serial interface is nearing throughput capacity. Note that any combination of bits is valid except the Command Accept (bit 7) and the Protocol Error (bit 6) simultaneously set.

Message Bytes

The number of required message bytes depends upon the particular command. Write commands require at least one message byte which typically specifies the code number of the switcher parameter to be changed. Additional message bytes are required for analog controls in which the bytes indicate the new value to which the analog control is to be set.

Read commands typically do not require a message byte. However, the Read Analog Control, Read Pushbutton/Lamp Control, and Read Lamp Status Map Commands do require message bytes that indicate the control or lamp to be read.

Section 3
PROTOCOL TABLES

INTRODUCTION

This section serves as a quick reference guide for using any Model 100 protocol command. Each command is located on a separate page with the command name at the top and the read and write command codes listed directly below the name. The commands are arranged in numerical order according to the read command code.

References to actual pushbuttons, potentiometers, lamps, and section names on the Model 100 control panel are shown in capital letters in the tables, which is how they appear on the control panel. Note that all values within the tables are hexadecimal, unless otherwise indicated by the notation of "decimal". Unless indicated as 00H or 01H, EX may be any value.

The following table lists the protocol commands and their order within this section.

Table 3-1. Command Location Table

Table 3-2. Crosspoint Command (41-44/C1-C4)

Function	Byte Count	Effects Address	Command Code	Message
READ:				
PROGRAM BACKGROUND Bus	02	EX	41	-
PRESET BACKGROUND Bus	02	EX	42	-
KEY BUS	02	EX	43	-
KEY BUS	02	EX	44	-
WRITE:				
PROGRAM BACKGROUND Bus	03	EX	C1	Crosspoint#
PRESET BACKGROUND Bus	03	EX	C2	Crosspoint#
KEY BUS	03	EX	C3	Crosspoint#
KEY BUS	03	EX	C4	Crosspoint#

The read command enables the editor to determine the crosspoint currently selected on the specified bus. The switcher responds by sending the write form of the command.

The write command enables the editor to select any crosspoint. Note that the 44 and C4 commands reference a key bus on the Model 300 switcher that is not on the Model 100. They are included here for completeness but function identically to the 43 and C3 commands, respectively.

The valid crosspoint numbers are 00H to 09H, with:
- 00H = BLACK crosspoint
- 01H to 08H = user-defined crosspoints
- 09H = COLOR BKGD crosspoint

If a crosspoint number greater than 09H is specified, then the BLACK (00H) crosspoint will be selected.

A special case exists between this write command and the control panel. If an operator at the control panel is pressing a crosspoint pushbutton when the editor (via the protocol) tries to set another crosspoint on that bus, the control panel selection will have priority and override the editor selection.

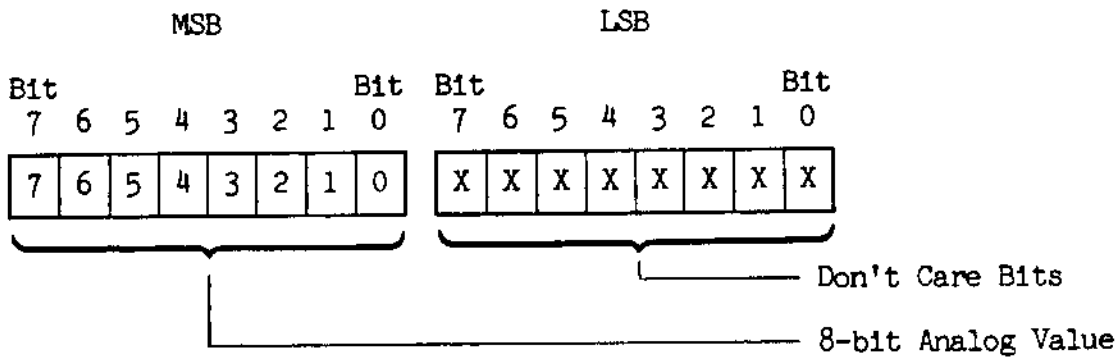
Table 3-3. Analog Control Command (45/C5)

Function	Byte Count	Effects Address	Command Code	Message
READ designated control	03	EX	45	Control#
WRITE designated control	05	EX	C5	Control# LSB MSB

The read command enables the editor to determine the current value of the designated analog control. The switcher responds by returning the write form of the command. The control number assigned to each analog control is shown in Table 3-4.

The write command sets the specified analog control to a new value. MSB and LSB (Most and Least Significant Bytes, respectively) indicate the 8-bit or 12-bit analog value of the control setting, as detailed below.

For an 8-bit analog value:



03 EX 45

For a 12-bit analog value:

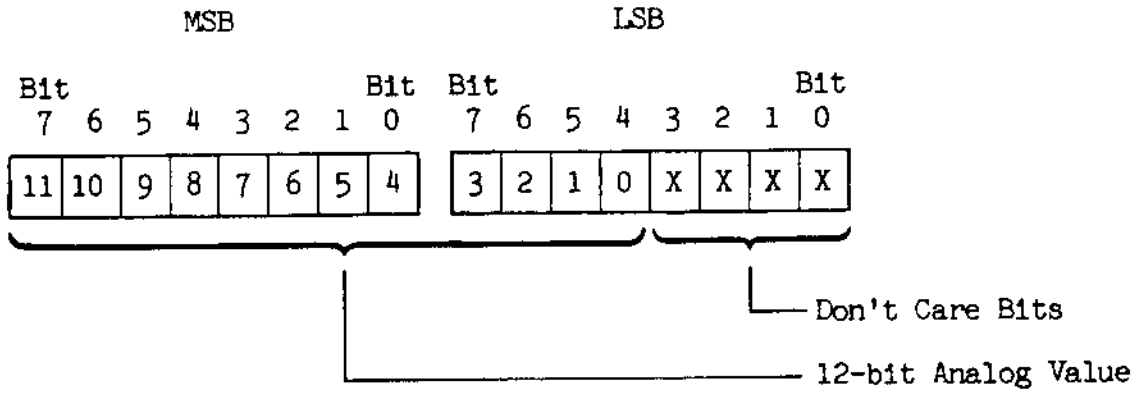


Table 3-4. Analog Control Numbers

Control #	EX	Control Name
08	00	DSK CLIP
0A	00	DSK MATTE HUE
0B	00	DSK MATTE CHROMA
0C	00	DSK MATTE LUM (Luminance)
00	01	Transition Lever Arm
0A	01	EFFECTS KEYER CLIP
0B	01	EFFECTS KEYER GAIN
11	01	POSITIONER (Vertical)
12	01	POSITIONER (Horizontal)
14	01	BACKGROUND HUE
15	01	MASK/PRESET SIZE
17	01	CHROMA KEY HUE
18	01	BORDER/EFF HUE
19	01	BORDER/EFF CHROMA
1A	01	BORDER/EFF LUM
1B	01	BACKGROUND LUM
1C	01	ASPECT
1D	01	SOFT (Border)
1E	01	BORDER (Width)
1F	01	BACKGROUND CHROMA

ØC BCS
ØD BCC

Table 3-5. Pushbutton/Lamp Control Command (46,47/C6,C7)

Function	Byte Count	Effects Address	Command Code	Message
READ designated PB/L (PB/L = Pushbutton/Lamp)	03	EX	46	PB/L#
	03	EX	47	PB/L#
WRITE:				
designated PB/L On	03	EX	C6	PB/L#
designated PB/L Off	03	EX	C7	PB/L#

The read command is used to determine the status of any pushbutton or lamp by returning the appropriate form of the write command, either "on" or "off". Commands 46 and 47 are identical. If an invalid read PB/L number is specified, the reply will indicate the status of PB/L 00H (PROGRAM BACKGROUND crosspoint 0).

The write commands turn the designated pushbutton and/or lamp on or off. Should an invalid PB/L number be used, the switcher ignores the command.

See Table 3-6 for the valid PB/L numbers.

There are a few distinct differences between this command and the Pushbutton Select command (FB) that should be noted. First of all, note that most of the switcher pushbuttons can be separated into three basic groups; 1) mutually exclusive (only one pushbutton can be selected at a time), 2) alternate action (one push it's on, the next push it's off), and 3) cyclic (pushing the button cycles it through three different selections, such as with the MATTE/BKGD SELECT pushbutton).

In the mutually exclusive groups, both the C6 (on) and FB commands turn off the currently illuminated pushbutton when another pushbutton is selected. However, no action is taken if the C7 (off) command attempts to turn off the currently illuminated pushbutton because one button must always be selected.

In the alternate action groups, the Pushbutton/Lamp command must issue the correct next state (on or off) of the pushbutton or else the command is ignored. The Pushbutton Select command, however, automatically sets the pushbutton to its next state, just as if it had been pushed at the control panel.

In the cyclic groups, the Pushbutton/Lamp command cannot write to these pushbuttons, it can only read their current status. The Pushbutton Select command, however, can set these groups to the desired selection.

There are two special cases associated with use of the Pushbutton/Lamp command that should be mentioned. First, this command can force an immediate cut of the Effects Keyer, the DSK, or the FTB functions by commanding the associated lamp (KEY ON, DSK ON, or FADE TO BLACK, respectively) on or off. The auto transition rate for that function is ignored and the function is immediately set to the commanded state, regardless of its present state (even if it's in the midst of a transition).

For example, to cut immediately out of black at the next vertical interval, write a "lamp off" command to the FTB lamp (03 EX C7 1F). To cut the DSK on air, write a "lamp on" command to the DSK ON lamp (03 EX C6 0D). To cut the effects key on air, write a "lamp on" command to the KEY ON lamp (03 EX C6 52). Note that when writing to the Effects Transition KEY ON lamp, the lever arm must be on a limit or the command is ignored.

The second special case is that the Pushbutton/Lamp command can be used to select both the BKGD and KEY buttons in the EFFECTS TRANSITION section by issuing a "lamp on" command to one lamp and then the other lamp. The Pushbutton Select command is unable to select both pushbuttons simultaneously. (Note that the Transition Mode command specifically controls the BKGD and KEY pushbuttons. This is the preferred command to use.)

Table 3-6. Pushbutton/Lamp Numbers (PB/L#)

PB/L Number	Read Function	Write Function
00	Program Bus Crosspoint 0	Program Bus Crosspoint 0
01	" " " 1	" " " 1
02	" " " 2	" " " 2
03	" " " 3	" " " 3
04	" " " 4	" " " 4
05	" " " 5	" " " 5
06	" " " 6	" " " 6
07	" " " 7	" " " 7
08	" " " 8	" " " 8
09	" " " 9	" " " 9
0A	Pgm. Bus High/Low Tally	--- Not Applicable ---
0B	AUTO TRANS	AUTO TRANS
0C	DSK MIX	DSK MIX
0D	DSK ON	DSK ON
0E	WIPE	WIPE
0F	MIX	MIX
10	Preset Bus Crosspoint 0	Preset Bus Crosspoint 0
11	" " " 1	" " " 1
12	" " " 2	" " " 2
13	" " " 3	" " " 3
14	" " " 4	" " " 4
15	" " " 5	" " " 5
16	" " " 6	" " " 6
17	" " " 7	" " " 7
18	" " " 8	" " " 8
19	" " " 9	" " " 9
1A	Pst. Bus High/Low Tally	--- Not Applicable ---
1B	ASPECT ON	ASPECT ON
1C	POSITIONER On	POSITIONER On
1D	REVERSE Wipe	REVERSE Wipe
1E	DSK PVW (Preview)	DSK PVW
1F	FADE TO BLACK	FADE TO BLACK
20	KEY BUS Crosspoint 0	KEY BUS Crosspoint 0
21	" " " 1	" " " 1
22	" " " 2	" " " 2
23	" " " 3	" " " 3
24	" " " 4	" " " 4
25	" " " 5	" " " 5
26	" " " 6	" " " 6
27	" " " 7	" " " 7
28	" " " 8	" " " 8
29	" " " 9	" " " 9

Table 3-6. Pushbutton/Lamp Numbers (continued)

PB/L Number	Read Function	Write Function
2A	KEY BUS High/Low Tally	--- Not Applicable ---
2B	OUTLINE	OUTLINE
2C	DROP SHADOW	DROP SHADOW
2D	BORDERLINE	BORDERLINE
2E	DSK MATTE FILL	DSK MATTE FILL
2F	DSK EXT VIDEO FILL	DSK EXT VIDEO FILL
30	Horizontal Wipe	Horizontal Wipe
31	Vertical Wipe	Vertical Wipe
32	Horizontal Split Wipe	Horizontal Split Wipe
33	Vertical Split Wipe	Vertical Split Wipe
34	Left Corner Wipe	Left Corner Wipe
35	Right Corner Wipe	Right Corner Wipe
36	Diagonal Wipe	Diagonal Wipe
37	Box Wipe	Box Wipe
38	Diamond Wipe	Diamond Wipe
39	Circle Wipe	Circle Wipe
3A	BACKGROUND Generator	--- Not Applicable ---
3B	DSK MATTE Generator	" "
3C	BORDER/EFF Matte Generator	" "
3D	FADE TO BLACK Rate	" "
3E	DSK MIX Rate	" "
3F	AUTO TRANS Rate	" "
40	DSK KEY INVERT	DSK KEY INVERT
41	DSK KEY MASK	DSK KEY MASK
42	DSK EXT SOURCE	DSK EXT SOURCE
43	DSK KEY BUS SOURCE	DSK KEY BUS SOURCE
44	EFFECTS KEYER KEY INVERT	EFFECTS KEYER KEY INVERT
45	EFFECTS KEYER KEY MASK	EFFECTS KEYER KEY MASK
46	EFF MATTE FILL	EFF MATTE FILL
47	EFFECTS KEYER KEY BUS FILL	EFFECTS KEYER KEY BUS FILL
48	BKGD	BKGD
49	KEY	KEY
4A	--- Not Applicable ---	CUT
4B	PST PTN (Preset Pattern)	PST PTN
4C	EFFECTS KEYER KEY BUS SOURCE	EFFECTS KEYER KEY BUS SOURCE
4D	EFF EXT SOURCE	EFF EXT SOURCE
4E	CHROMA KEY	CHROMA KEY
4F	EDITOR ENABLE	--- Not Applicable ---
50	Lever Arm Limit Low	" "
51	Lever Arm Limit High	" "
52	KEY ON	KEY ON

Table 3-7. Wipe Pattern Command (48/C8)

Function	Byte Count	Effects Address	Command Code	Message
READ wipe pattern	02	EX	48	-
WRITE wipe pattern	03	EX	C8	Wipe#

The read command replies with the wipe number of the currently selected wipe pattern. The write command selects the specified wipe pattern. Only one pattern can be active at a time.

Table 3-8 lists the valid wipe numbers for the Model 100. Note that the numbers are not sequential because they are derived from the numerous patterns of the Model 300. If an invalid wipe pattern number is specified, the horizontal wipe (0AH) is selected.

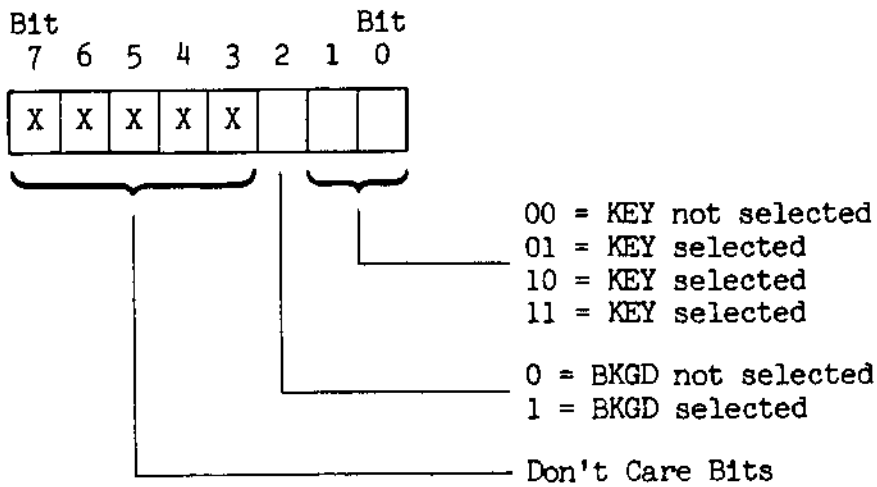
Table 3-8. Wipe Pattern Numbers

Wipe Number	Wipe Pattern
00	Vertical Wipe
01	Left Corner Wipe
03	Circle Wipe
04	Diagonal Wipe
0A	Horizontal Wipe
0B	Right Corner Wipe
14	Vertical Split Wipe
17	Box Wipe
1E	Horizontal Split Wipe
21	Diamond Wipe

Table 3-9. Transition Mode Command (4A/CA)

Function	Byte Count	Effects Address	Command Code	Message
READ Transition mode	02	EX	4A	-
WRITE Transition mode	03	EX	CA	Mode

This command reads from and writes to the BKGD and KEY pushbuttons in the Effects Transition section. The mode byte has the following format.



For a write, at least one bit (0,1, or 2) must be set or else the command is ignored by the switcher. Note that either bit 0 or bit 1 can select the KEY transition mode. Therefore, ensure that both bits are zero when a KEY transition is not desired.

Table 3-10. Transition Rate Command (4C,4D,7D/CC,CD,FD)

Function	Byte Count	Effects Address	Command Code	Message
READ:				
AUTO TRANS Rate	02	EX	4C	-
DSK MIX Rate	02	EX	4D	-
FADE TO BLACK Rate	02	EX	7D	-
WRITE:				
AUTO TRANS Rate	05	EX	CC	Ratel,2,3
DSK MIX Rate	05	EX	CD	Ratel,2,3
FADE TO BLACK Rate	05	EX	FD	Ratel,2,3

This command reads and writes the rate at which the switcher will perform the indicated transition. The rate is specified in frames from 000 to 999. To translate frames to seconds when using the NTSC or PAL-M standard:

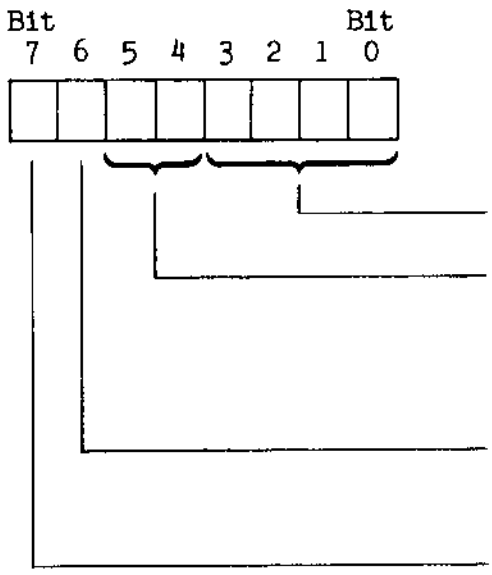
30 frames = approximately one (1) second, therefore;

frame rate = transition time in seconds X 30 frames/second

For example, for a four (4) second FTB, the frame rate is 120 frames (4 seconds X 30 frames/second = 120 frames). For the PAL-I standard, use 25 frames/seconds.

Note that the frame display on the control panel actually has four digits. The fourth (leftmost) digit appears only during control panel diagnostics and is not accessible with this command.

The rate bytes have the following format.



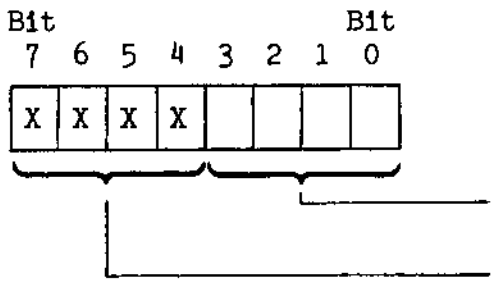
Ratel = Transition control bits and most significant digit of rate

Rate value in BCD (0000 to 1001)

00 = KEY not selected
01 = KEY selected
10 = KEY selected
11 = KEY selected

0 = BKGD not selected
1 = BKGD selected

0 = Update display only, do not perform the transition
1 = Update the display and perform the transition



Rate2 = Next most significant digit
Rate3 = Least significant digit

BCD value of this digit (0000 to 1001)

Don't Care Bits

Table 3-11. Key Memory Command (53/D3)

Function	Byte Count	Effects Address	Command Code	Message
READ: KEY Input Settings	02	EX	53	-
WRITE: KEY Input Settings	62	EX	D3	d0 - d95 data bytes (decimal)

The read function of this command causes the switcher to transmit to the editor the 8-bit analog values for the current settings of the following controls.

EFFECTS KEYER:
- o KEY BUS GAIN and CLIP for all ten KEY BUS inputs
- o EFF EXT GAIN and CLIP
- o CHROMA KEY HUE, GAIN, and CLIP

DOWNSTREAM KEYER:
- o DSK EXT CLIP
- o DSK KEY BUS CLIP for all ten KEY BUS inputs

The 96 bytes of analog values are transmitted in the form of the write command, thus the editor saves the values and writes them back to the switcher at a later time. The 96 bytes allow for future needs and the switcher sets unused bytes to zeros. Note that the editor should not change any of the data bytes.

Table 3-12. Learn E-MEM Command (-/DA)

Function	Byte Count	Effects Address	Command Code	Message
WRITE Learn Status into E-MEM	03	EX	DA	Register#

This is a write only command. It causes the entire switcher status (configuration) to be learned into the specified 112-byte E-MEM "register". There are sixteen E-MEM registers, thus the valid register numbers are 00H to 0FH.

To access the configuration data in the E-MEM registers, use the RECALL E-MEM or TRANSFER E-MEM commands described in Tables 3-13 and 3-22, respectively.

Table 3-13. Recall E-MEM Command (-/DB)

Function	Byte Count	Effects Address	Command Code	Message
WRITE Recall E-MEM to Switcher	03	EX	DB	Register#

This is a write only command. The configuration data in the specified E-MEM register is recalled into the switcher which configures it to those stored settings. The valid register numbers are 00H to 0FH.

Note that specifying 16H as a register number causes the switcher to execute the system reset routine.

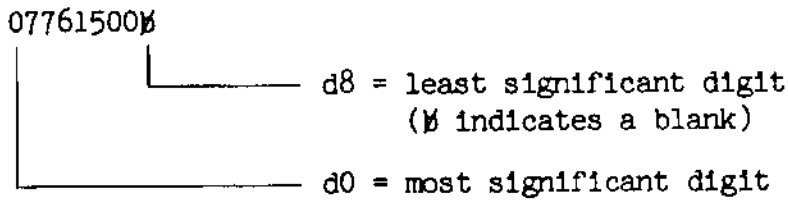
Table 3-14. Software Version Command (6C/EC)

Function	Byte Count	Effects Address	Command Code	Message
READ Software Version	02	EX	6C	-
WRITE Software Version	0B	EX	EC	d0 - d8 data bytes (decimal)

The read command causes the switcher to report its 9-digit software version number by returning the write form of the command. The d0 through d8 bytes are the ASCII representation of the software version number, with d0 being the most significant digit and d8 being the least significant digit, as shown in the following diagram.

The write command is shown to remain consistent with the protocol structure and is not intended to be sent to the switcher as it will be ignored.

Sample of a software version number:



The software version number is typically numeric. The ASCII codes for the numbers 0 through 9 are 30H through 39H, respectively. The blank character is ASCII code 20H. Note that in written documentation, the software version number contains a hyphen. It is not included here.

Table 3-15. Field Mode Command (6D/ED)

Function	Byte Count	Effects Address	Command Code	Message
READ Field Mode Setting	02	EX	6D	-
WRITE Field Mode Setting	03	EX	ED	Mode

The write command is used to enable or disable field marks and/or status update marks. The read command is used to report the current mode settings. When the switcher receives the break character, the field marks and the status update modes are disabled.

The write form of this command is an exception to the EDITOR ENABLE on/off criteria. The switcher will execute the command and set the specified mode even when the EDITOR ENABLE is off.

Field Marks. When enabled, a field mark is generated by the switcher once per field and sent to the editor shortly after vertical blanking. The field mark is a 2-byte response of 01H 01H in which the first byte is the byte count and the second byte is the "mark".

Status Update Mode. When this mode is enabled, the switcher will transmit a STATUS UPDATE command (EE) whenever any status data is changed (see the STATUS UPDATE command for details on the status data).

The mode byte format is shown here.

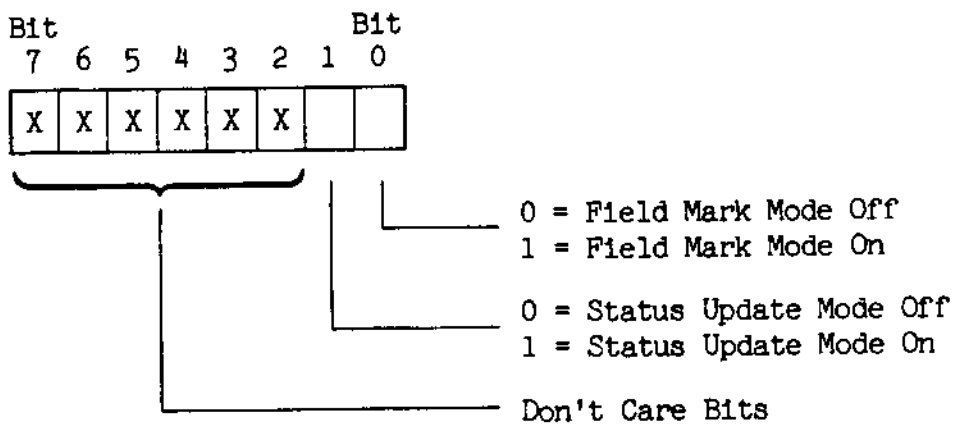


Table 3-16. Status Update Command (-/EE)

Function	Byte Count	Effects Address	Command Code	Message
WRITE: Status Update Bytes	09	EX	EE	d0 - d6 status bytes (decimal)

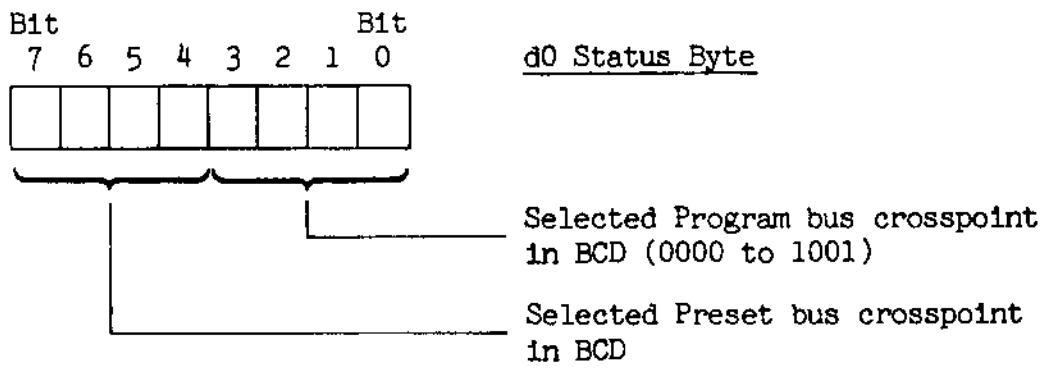
This command is sent to the editor by the switcher when the status update mode is enabled (see the FIELD MODE command) and a change has occurred in the status data. This command is used to remain consistent with the protocol structure and is not intended to be sent to the switcher as it will be ignored.

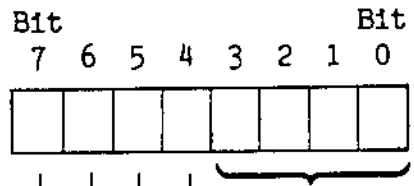
The switcher transmits this command at the approximate mid-point of the field. If a great deal of control panel processing is occurring, the transmission will be delayed.

The status byte reflects what the switcher configuration will be after the following vertical interval. Thus, when the serial interface is operating at a 19,200 or 38,400 (preferred) baud rate, the editor receives the updated status approximately one-half field before the actual change occurs.

Since this command is ten bytes long, operation of the serial interface at 9600 baud or less will result in the status information overrunning the beginning of the following field.

The format of the status bytes is as follows.





d1 Status Byte

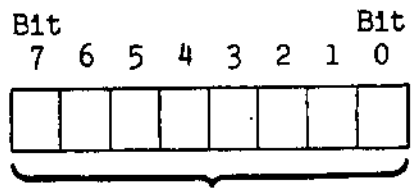
Selected Key bus crosspoint in BCD

0 = Effects key full off or being inserted
1 = Effects key full on or being removed

0 = KEY transition not selected
1 = KEY transition selected

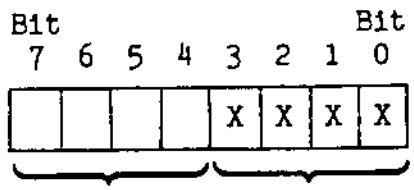
0 = BKGD transition not selected
1 = BKGD transition selected

0 = MIX transition type selected
1 = WIPE transition type selected



d2 Status Byte

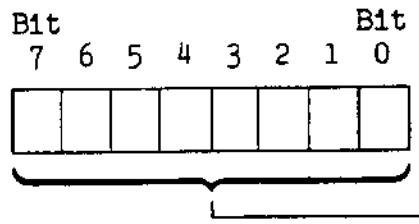
Most significant 8 bits of 12-bit binary value indicating effects lever arm position



d3 Status Byte

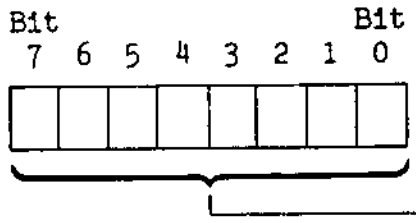
Don't Care Bits

Least significant 4 bits of effects lever arm position value



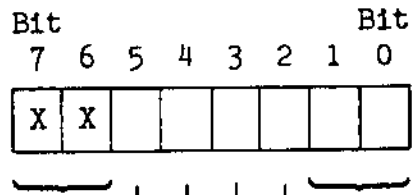
d4 Status Byte

DSK MIX transition value in binary



d5 Status Byte

FTB transition value in binary



d6 Status Byte

00 = KEY BUS is effects source
01 = CHROMA KEY is effects source
10 = EFF EXT is effects source
11 = PST PTN is effects source

0 = KEY BUS is effects fill
1 = EFF MATTE is effects fill

0 = Editor disabled
1 = Editor enabled

0 = DSK EXT is DSK source
1 = KEY BUS is DSK source

0 = DSK MATTE is DSK fill
1 = EXT VIDEO is DSK fill

Don't Care Bits

Table 3-17. All Stop Command (-/F2)

Function	Byte Count	Effects Address	Command Code	Message
WRITE	03	EX	F2	d0

This command stops all ongoing transitions, sets the lever transition to the limit it was leaving, removes all keys, sets the next transition to BKGD only, sets the transition type to MIX, and if currently faded to black, brings the switcher out of black.

The d0 byte is included to remain consistent with the Model 300 version of this command. This byte may be set to any value, but the switcher will ignore it.

Table 3-18. Lamp Status Map Command (78/F8)

Function	Byte Count	Effects Address	Command Code	Message
READ Lamp Status	03	EX	78	00
WRITE Lamp Status	13	EX	F8	00 d0 - d15 status bytes (decimal)

The read command transmits to the editor the status of all the switcher lamps. A 16-byte table is created with each bit of the sixteen bytes representing the on (bit = 1) or off (bit = 0) state of a lamp. The table was established for accommodating up to 128 lamps for the Model 300. However, the Model 100 only has 82 lamps and hence any unused bits are set to zero.

The read function replies with the write form of the command. The write command is included to remain consistent with the protocol structure and is not intended to be sent to the switcher as it will be ignored.

The Table 3-19 illustrates the relationships between the bits of the status bytes and the associated lamp numbers in hex. Refer to the "Read Function" column of Table 3-6 (under the Pushbutton/Lamp Control command) for the specific lamps that correlate to the lamp numbers 00H to 52H.

Table 3-19. Lamp Status Map

Bit								Byte/Lamp Association
7	6	5	4	3	2	1	0	
07	06	05	04	03	02	01	00	Byte 0 = Lamps 00 - 07
0F	0E	0D	0C	0B	0A	09	08	Byte 1 = Lamps 08 - 0F
17	16	15	14	13	12	11	10	Byte 2 = Lamps 10 - 17
				•				•
				•				•
				•				•
-	-	-	-	-	52	51	50	Byte 10 = Lamps 50 - 57 (bits 3 - 7 = 0)
-	-	-	-	-	-	-	-	Byte 11 = Lamps 58 - 5F (all bits = 0)
				•				•
				•				•
				•				•
7F	7E	7D	7C	7B	7A	79	78	Byte 15 = Lamps 78 - 7F (all bits = 0)

Table 3-20. Pushbutton Select Command (-/FB)

Function	Byte Count	Effects Address	Command Code	Message
WRITE Pushbutton	03	EX	FB	Pushbutton#

This write only command performs a "push" of the specified pushbutton number just as if the button had been pressed at the control panel. For details on the difference between this command and the write functions of the Pushbutton/Lamp Control command, refer to the latter command description.

The Table 3-21 lists the valid pushbutton numbers for this command. If an invalid number is specified, the command is ignored.

Table 3-21. Pushbutton Numbers

Pushbutton Number	Description
00	PROGRAM BACKGROUND Bus Crosspoint 0
01	" " " " 1
02	" " " " 2
03	" " " " 3
04	" " " " 4
05	" " " " 5
06	" " " " 6
07	" " " " 7
08	" " " " 8
09	" " " " 9
0A	--- Not Applicable ---
0B	AUTO TRANS
0C	DSK MIX
0D	DSK CUT
0E	WIPE
0F	MIX

Table 3-21. Pushbutton Numbers (continued)

Pushbutton Number	Description
10	PRESET BACKGROUND Bus Crosspoint 0
11	" " " " 1
12	" " " " 2
13	" " " " 3
14	" " " " 4
15	" " " " 5
16	" " " " 6
17	" " " " 7
18	" " " " 8
19	" " " " 9
1A	--- Not Applicable ---
1B	ASPECT ON
1C	POSITIONER On
1D	REVERSE Wipe
1E	DSK PVW
1F	FADE TO BLACK
20	KEY BUS Crosspoint 0
21	" " " 1
22	" " " 2
23	" " " 3
24	" " " 4
25	" " " 5
26	" " " 6
27	" " " 7
28	" " " 8
29	" " " 9
2A	--- Not Applicable ---
2B	OUTLINE
2C	DROP SHADOW
2D	BORDERLINE
2E	DSK MATTE FILL
2F	DSK EXT VIDEO FILL
30	Horizontal Wipe
31	Vertical Wipe
32	Horizontal Split Wipe
33	Vertical Split Wipe
34	Left Corner Wipe
35	Right Corner Wipe
36	Diagonal Wipe
37	Box Wipe
38	Diamond Wipe
39	Circle Wipe

Table 3-21. Pushbutton Numbers (continued)

Pushbutton Number	Description
3A	--- Not Applicable ---
3B	AUTO TRANSITION RATE SELECT
3C	MATTE/BKGD SELECT
3D	SET for Hundreds Increment
3E	SET for Tens Increment
3F	SET for Ones Increment
40	DSK KEY INVERT
41	DSK KEY MASK
42	DSK EXT SOURCE
43	DSK KEY BUS SOURCE
44	EFFECTS KEYER KEY INVERT
45	EFFECTS KEYER KEY MASK
46	EFF MATTE FILL
47	EFFECTS KEYER KEY BUS FILL
48	BKGD
49	KEY
4A	CUT
4B	PST PTN
4C	EFFECTS KEYER KEY BUS SOURCE
4D	EFF EXT SOURCE
4E	CHROMA KEY
4F	EDITOR ENABLE

Table 3-22. Transfer E-MEM Register Command (7E/FE)

Function	Byte Count	Effects Address	Command Code	Message
READ E-MEM to Editor	03	EX	7E	Register#
WRITE Editor to E-MEM	73	EX	FE	Register# d0 - d111 (decimal)

The read command transfers the contents of the specified E-MEM register to the editor. The write command transfers the previously retrieved register contents from the editor back to a specified E-MEM register. The valid register numbers are 00H to 0FH (0 to 15). The register length is 112 bytes. Note that the editor must not alter the register contents.

A short cut may be performed when using the READ and WRITE commands by specifying a register number of 1FH. For a read command, this automatically causes: 1) a LEARN E-MEM command to be executed in which the switcher configuration is learned into E-MEM register 0FH (15); and 2) the register contents are then immediately transferred to the editor. For a write command, using 1FH automatically causes: 1) the editor to transfer the data into E-MEM register 0FH; and 2) a RECALL E-MEM command is immediately executed in which the contents of E-MEM register 0FH are transferred to the switcher.

Note that the read command, when using register number 1FH, will be executed when the EDITOR ENABLE pushbutton is off. However, it will not perform the learn portion of the command because LEARN E-MEM is a write only command. Hence, whatever data is currently in register 0FH (the last data learned into it or meaningless data after a system reset) is sent to the editor.