Seven-Track Feature

The seven-track compatibility feature installed in the control unit allows Models 1, 2, and 3 of 2400 tape units (with seven-track read/write heads) to read or write magnetic tape in IBM 729 or 7330 tape format. Reading or writing may be done at densities of 200, 556, or 800 bytes per inch. Odd or even parity checking is provided. Interblock gaps are approximately 0.75 inch. Character density and type of parity checking are selected by the modifier bits in the command byte (Figure 13).

The translator of the seven-track compatibility feature is bidirectional; it translates eight-bit bytes from main storage to six-bit BCD tape characters and translates six-bit BCD tape characters to eight-bit bytes for main storage. The translator is set or reset by a control command. (Figure 13.)

Figures 14 and 15 show the 256 byte configurations and the associated graphics for the Extended Binary Coded Decimal Interchange Code (EBCDIC) and the American Standard Code for Information Interchange (ASCII) extended to eight bits. Figure 16 shows the same 256 byte configurations of codes as shown in Figures 14 and 15 but with a six-bit BCD tape code graphic (standard BCD interchange code).

To translate an eight-bit byte to a six-bit BCD tape character, locate the eight-bit byte configuration of the desired character in Figure 16 and identify the graphic. Find the identical graphic in Figure 17 to determine the six-bit BCD tape code.

Bit Positions → 01 / 23 / 4567	00 00	00 01	00 10	00 11	01 00	01 01	01 10	01 11	10 00	10 01	10 10	10 11	11 00	11 01	11 10	11 11
0000			DS		SP	&	-									0
0001			SOS				/		a	j			A	J		1
0010			FS						b	k	s		B	K	S	2
0011									c	l	t		C	L	T	3
0100	PF	RES	BYP	PN					d	m	u		D	M	U	4
0101	HT	NL	LF	RS					e	n	v		E	N	V	5
0110	LC	BS	EOB	UC					f	o	w		F	O	W	6
0111	DEL	IL	PRE	EOT					g	p	x		G	P	X	7
1000									h	q	y		H	Q	Y	8
1001									i	r	z		I	R	Z	9
1010			SM		¢	!		:								
1011					.	$	,	#								
1100					<	*	%	@								
1101					(	)	-	'								
1110					+	;	>	=								
1111						—	?	"								

Example: A is represented by bit configuration 11 00 0001

Note: 1. Graphic representations are undefined for the bit-patterns outside the heavily-outlined portions of the chart. These bit-patterns are referred to as undefined-graphic bit-patterns.

2. If an undefined-graphic bit-pattern is sent from main storage to the tape unit, the bit-pattern that will be recorded by the tape unit is not specified.

3. The bit-pattern recorded by the tape unit for an undefined graphic bit pattern sent from main storage may be different from that recorded by other devices.

4. IBM reserves the right to change at any time the bit-pattern recorded by the 2400 tape unit for an undefined-graphic bit-pattern sent from main storage.

Figure 14. Extended Binary Coded Decimal Interchange Code

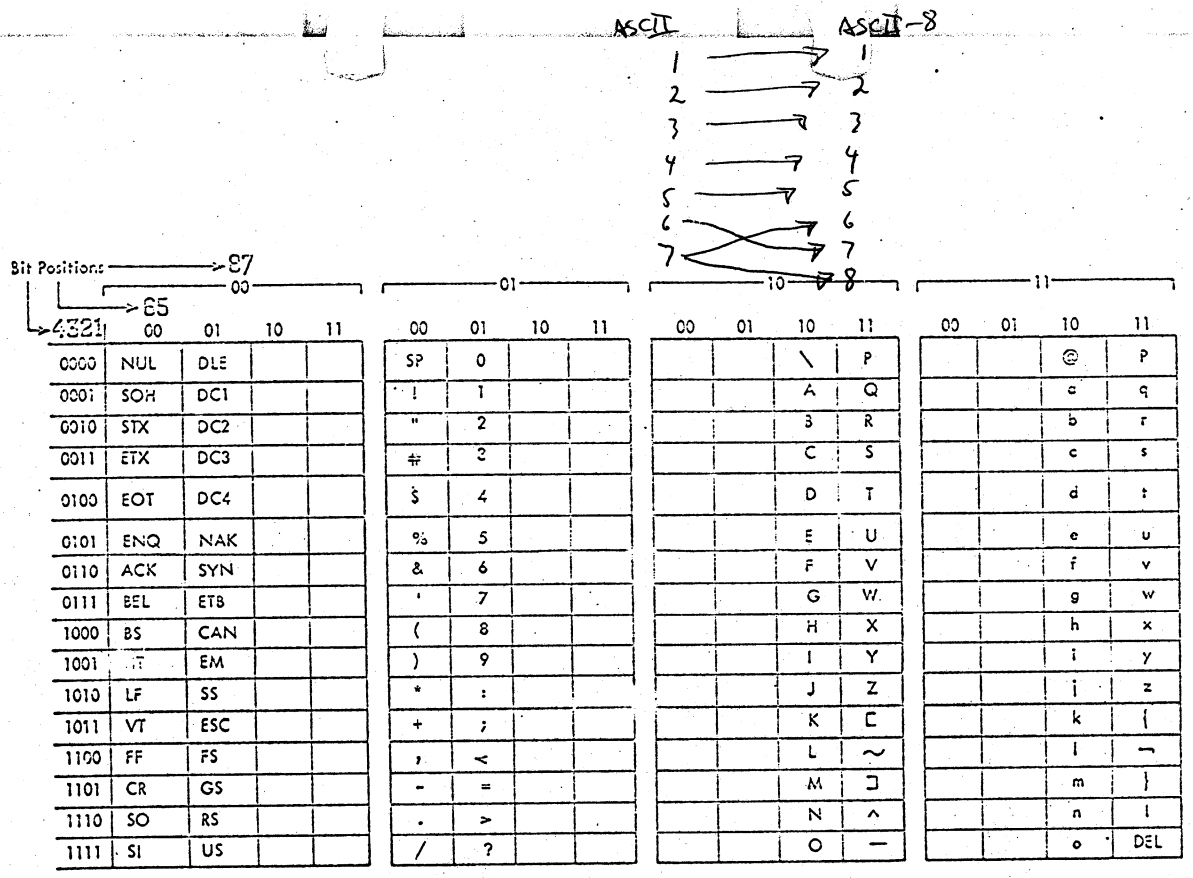

Figure 15. Eight-Bit Representation for American Standard Code for Information Interchange for Use in Eight-Bit Environment (ASCII-8)

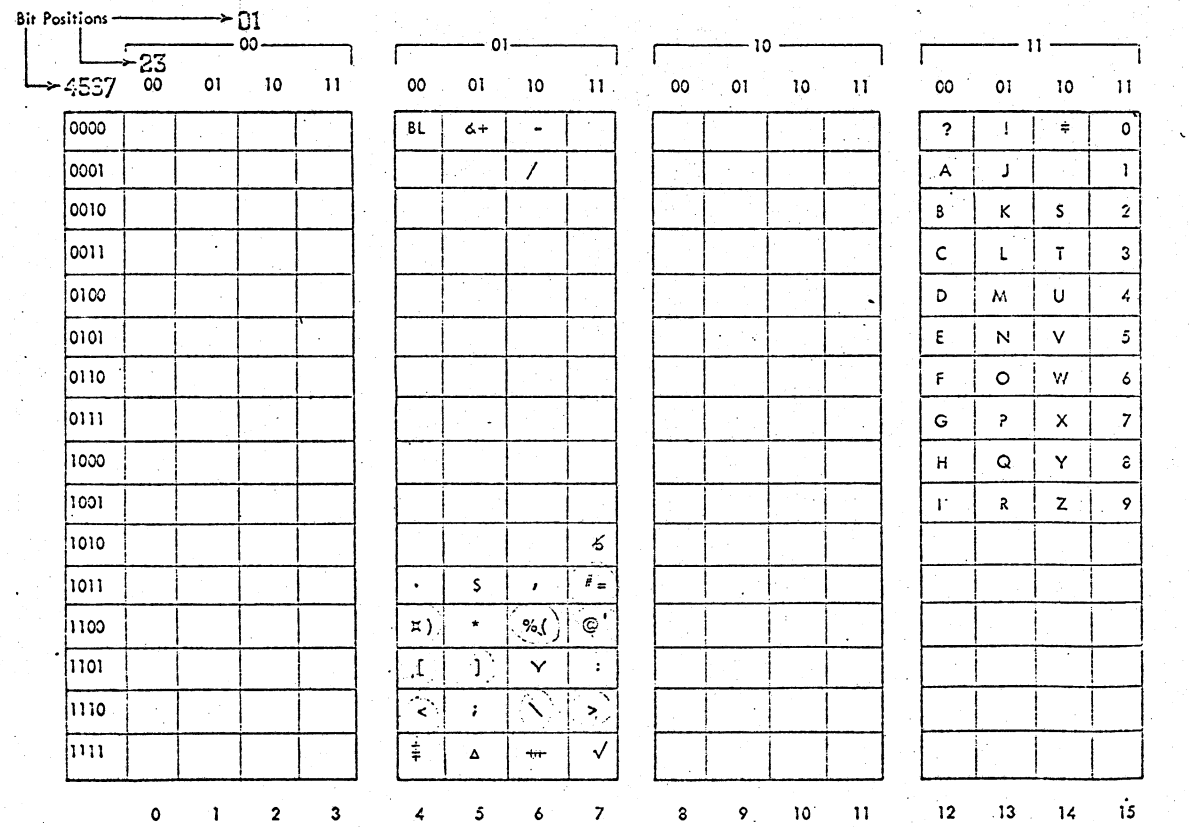

Figure 16. Translation Chart — Extended BCD Interchange Code to BCD Interchange Code

Even parity tape requires one exception to this procedure. In even redundancy mode, regardless of the translator setting, the eight-bit code for blank is translated to substitute blank in six-bit tape code, and the six-bit tape character substitute blank is translated to blank in eight-bit code.

To translate a six-bit BCD tape code character to an eight-bit byte, identify the graphic for the six-bit BCD tape character in Figure 17. Find the identical graphic in Figure 16 to determine the eight-bit configuration.

	--	-A	B-	BA
----	bl	ъ	-	&
---1	1	/	J	A
--2-	2	S	K	B
--21	3	T	L	C
-4--	4	U	M	D
-4-1	5	V	N	E
-42-	6	W	O	F
-421	7	X	P	G
8---	8	Y	Q	H
8--1	9	Z	R	I
8-2-	ø	∓	!	?
8-21	# =	,	$	.
84--	@	% (	*	;)
84-1	:	∨	]	[
842-	>	\	;	<
8421	√	+++	Δ	≠

Figure 17. Standard BCD Interchange Code and Graphics

NOTE: In main storage, the bit-patterns for EBCDIC graphics are not necessarily the same as the bit-patterns for the BCDIC graphics when read from tape on the 2400 tape units (Figures 14 and 16; also see Figure 18 for proper names of graphics).

If in the seven-track mode the translator is off and the data converter is off or nonexistent, data transfer takes place as shown in Figure 19.

In a write operation, the six low-order bits in each data byte are written on tape as illustrated in Figure 19. Any bits in the two high-order positions are ignored. In a read operation each character on tape becomes the six low-order bits in a storage data byte. Zero bits are inserted in the two high-order positions.

Data Conversion Feature

The data conversion feature, an additional option to the seven-track feature, allows the writing and reading of binary data on seven-track 2400 tape units. Data conversion is set by a control command and forces odd redundancy. Data conversion is as follows:

Symbol	Name
bl	Blank (Space)
ъ	Substitute Blank
-	Minus Sign, Hyphen
&	Ampersand
/	Slash
\	Backslash
<	Less-Than Sign
>	Greater-Than Sign
#	Number Sign
@	At Sign
*	Asterisk
¤	Lozenge
'	Prime, Apostrophe
(	Left Parenthesis
)	Right Parenthesis
[	Left Bracket
]	Right Bracket
∓	Record Mark
≠	Group Mark
Δ	Mode Change
+++	Segment Mark
√	Tape Mark (Radical)
∨	Word Separator
=	Equal Sign

Figure 18. Symbol Names

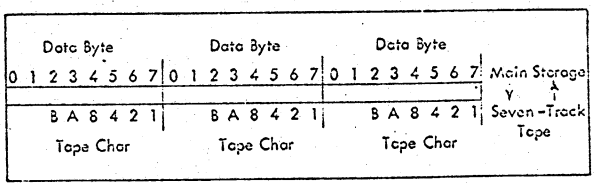

Figure 19. Data Translation-Translator Off and Converter Off

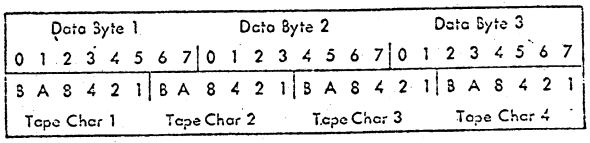

Figure 20. Data Conversion

Write operation — Writing a tape with converter on results in writing four tape characters (24 bits) for every three storage bytes (24 bits). (See Figure 20.) Reading such a tape reverses the process by converting four tape characters into three storage bytes.* When data written from storage is not a multiple of three bytes, the last one or two bytes are written as follows:

*Data conversion reduces the data transfer rate to ⅔ of the rate for nine-track NRZI operation.

One byte is converted to two tape characters; bits 8, 4, 2, 1 of the second character are written as zeros; two bytes are written as three tape characters; bits 2 and 1 of the third character are written as zeros.

Read operation — The first 24 bits of the tape block (four tape characters) are converted to three eight-bit data bytes in main storage. Tape and storage bit relationships are shown in Figure 20.

Data conversion cannot be done reading backward. A read backward command overrides data converter on.

When reading tape written in the data conversion mode, the number of characters read back is always the same as the number of characters written, and data conversion check is never indicated. When data read from tape not written in the data conversion mode is not a multiple of four characters in length, the last one, two, or three characters of each block are converted as follows.

One tape character is converted to one data byte with bits 6 and 7 of the data byte set to 0. Unit check and data conversion check are set.

Two tape characters are converted to one data byte if bits 8, 4, 2, and 1 of the second tape character are all 0. Unit check and data converter check are not set. If bits 8, 4, 2 and 1 are not all 0, the two tape characters are converted to two data bytes with bits 4, 5, 6, and 7 of the second byte set to 0. Unit check and data converter check are set.

Three tape characters are converted to two bytes if bits 2 and 1 of the third character are 0. Unit check and data converter check are not set. If bits 2 and 1 are not 0, the three tape characters are converted to three data bytes with bits 2, 3, 4, 5, 6, and 7 of the third byte set to 0. Unit check and data converter check are set.

NOTE: If tapes are read in the data conversion mode and the tapes had been either generated externally or written in some other mode, it is possible to determine the exact content and length of the block by using a combination of byte length and data conversion check, as follows.

Determine the modulo 3 remainder byte count (remainder after division by 3) of the number of bytes transferred to main storage and the setting of the data converter sense bit. Use Figure 21 to determine the necessary adjustment of the data field length.

During read/write operations, an odd/even count is made for each group of 24 bits before and after data conversion. If the counts do not compare, unit check is set in the status byte, and C compare and equipment check are set in the sense byte. The data converter off and translator off operation is described under "Seven-Track Feature" (Figure 19).

Bytes Remainder	Data Converter Sense Bit	Characters From Tape	Bit Position-Last Tape Bit		Adjustment of Data Field
			Byte	Bit	
0(3)	Off	4	3	7	None
0(3)	On	3	3	1	Delete six 0 bits
1	Off	2	2	3	Add four 0 bits
1	On	1	1	5	Delete two 0 bits
2	Off	3	3	1	Add two 0 bits
2	On	2	2	3	Delete four 0 bits

Figure 21. Data Field Conversion Adjustment

Dual Density Feature

The dual density feature, available with the Models 4, 5, and 6 of the 2400 tape units, allows the program to utilize the tape unit as either an 800 bpi or a 1600 bpi machine. The nine-track, 800 bpi NRZI compatibility feature (or the seven- and nine-track 800 bpi NRZI compatibility feature) is a control unit prerequisite to the dual density feature. With the dual density feature installed, the tape unit can read and write tape compatible with all models (nine-track) of 2400 tape units.

To set the desired writing density, the channel program issues a mode setting control command (Figure 13) to the tape control unit to indicate a density setting of either 800 bpi or 1600 bpi. The mode setting is transferred to any tape unit (Model 4, 5, or 6) that performs a write, write tape mark, or erase gap operation starting at load point. The setting holds for that tape unit until the tape is returned to load point.

The read operation requires no mode setting command. The tape unit will be set to read at the density indication on the tape at load point. A burst of bits in the P track between load point and the first recorded tape block identifies the 1600 bpi tape to the tape unit. The lack of this burst of bits identifies the 800 bpi tape.

Nine-Track 800 bpi Compatibility Feature

This control unit feature allows a Model 4, 5, or 6 tape drive (which has the dual density feature installed) to read and write nine-track 800 bpi NRZI tapes as well as 1600 bpi phase-encoded tapes. This dual density capability eliminates the need for additional nine-track 800 bpi drives in installations having or desiring mixed density nine-track libraries. (Operation of Models 1, 2, and 3,800 bpi tape drives is also allowed.)