TELETYPE™
4500
SYSTEM

POCKET REFERENCE

Second

4540 Synchronous Data Terminal

Technical Reference
Part 2, Article 2
Issue 2, March 1979

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GENERAL

Foreword This pocket reference contains information that a computer programmer may need in order to implement a computer communications system using Teletype™ 4540 data terminals on multipoint private-line communications facilities.

Only message transfer and communications establishment and termination are covered in this reference. When to poll, select, process and recover are beyond its scope.

It is assumed that the reader has read the 4540 Catalog which covers features, options and technical facts and the 4540 Technical Reference which covers system operation; and that the reader will contact the nearest sales representative for any additional information that may be required.

The publisher reserves the right to revise this reference for any reason, including, but not limited to: conformity with standards promulgated by ANSI, EIA or similar agencies, utilization of new advances in the state of technical arts, or to reflect changes in the design of equipment.

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Abbreviations

(ASCII and EBCDIC Code abbreviations on page 19 and 20)

AA_1	Attribute Address +1, 1st char	
AA_2	Attribute Address +1, 2nd char	
AC	Attribute Character	
ACK	Acknowledge	
AID	Attention Identification	
ANSI	American Nat'l Standards Inst	
ASCII	American Standard Code for Information Interchange	
BA_1	Buffer Address, 1st character	
BA_2	Buffer Address, 2nd character	
BCC	Block Check Character	
Bsy	Busy	
C	Specifiable Character	
CA_1	Cursor Address, 1st character	
CA_2	Cursor Address, 2nd character	
CC	Cluster Controller	
CCC	Copy Control Character	
Cmd	Command	
CRC	Cyclical Redundancy Check	
DA	Device Address	
DUP	Duplicate	
EIA	Electronic Industries Association	
EUA	Erase Unprotected to Address	
IC	Insert Cursor	
ITB	End of Intermediate Trans'n Block	
KD	Keyboard Display	
Msg	Message	
MSBR	Magnetic Stripe Badge Reader	
Msg	Message	
Mod'd	Modified	
P	Printer	
PAD	Pad	
PT	Program Tab	
Ptg	Printing	
RA	Repeat to Address	
Rec	Receive	
Rd	Read	
Rdy	Ready	
RVI	Reverse Interrupt	
SBA	Set Buffer Address	
SF	Start Field	
SPA	Station Polling Address	
Spec	Specific	
SS_1	Status & Sense, 1st character	
SS_2	Status & Sense, 2nd character	
S&S	Status & Sense	
SSA	Station Selection Address	
Stn	Station	
WACK	Wait Acknowledge	
WCC	Write Control Character	

Glossary

Blink	— Flash between half & normal brightness
Field	— AC and characters following it
General Poll	— Causes lowest numbered device with message to send, unless a higher numbered has not had its turn
Hidden	— Not displayed/printed
Highlight	— Intensify/blink
Intensify	— Display above normal brightness
Modify	— by operator entry
Numeric	— Numbers, –, DUP and .
Protect	— from operator entry
Specific Poll	— Causes only device polled to send if it has a message

Symbols

/ = or
[ ] = optional possibility

Ideas for Simplifying the Testing of a New Data Communications System

When the overall system is designed, sharply distinguish between the data communication and the data processing functions, and write the software so that data processing problems will not affect the testing of communications routines.

When the original communications software is written, incorporate test routines to log the contents of the computer memory before and after each send or receive operation.

Be sure that the options specified for the 4540 stations perform the desired functions at the time of installation.

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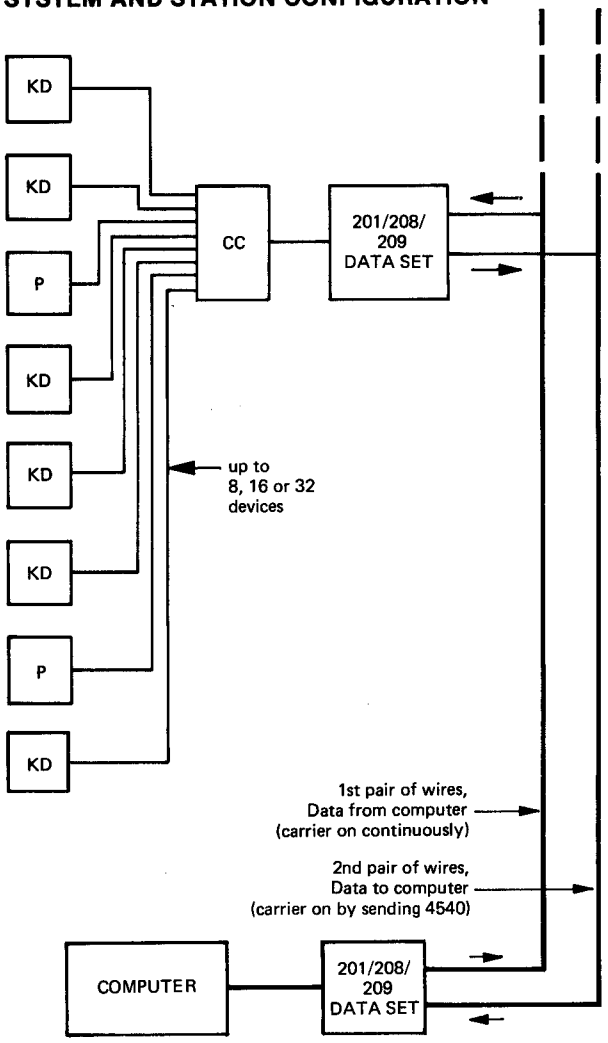
SYSTEM AND STATION CONFIGURATION



Station Identification

Stn or Dvce No.	SPA	SSA	DA	Stn or Dvce No.	SPA	SSA	DA
0	SP	-	SP	16	&	0	&
1	A	/	A	17	J	1	J
2	B	S	B	18	K	2	K
3	C	T	C	19	L	3	L
4	D	U	D	20	M	4	M
5	E	V	E	21	N	5	N
6	F	W	F	22	O	6	O
7	G	X	G	23	P	7	P
8	H	Y	H	24	Q	8	Q
9	I	Z	I	25	R	9	R
10	[¢	¦	[¢	26	] !	:	] !
11	.	,	.	27	$	#	$
12	<	%	<	28	*	@	*
13	(	_	(	29	)	'	)
14	+	>	+	30	;	=	;
15	! ¦	?	! ¦	31	^ ¬	"	^ ¬

where 2 characters are shown:
ASCII on left, EBCDIC on right

COMPUTER...

...Communications Capabilities

Computer can:

Poll & receive (a) message(s) from a 4540 [then send a message to the 4540 [and then receive a message from the 4540]]

Select & send (a) message(s) to a 4540 [then receive a message from the 4540]

Select & receive a message from a 4540

Cause re-transmission of any message [block] received with invalid BCC[or invalid 8th bit on any character in message [block] if ASCII]

Messages to computer are blocked; messages from computer may be blocked

...Procedures for Line Control

Computer Functions / Computer Operations	Poll 4540, receive reply	Receive next block	Cause 4540 to re-send block	Reply not recognized by 4540	Cause 4540 to abort trans'n	Select 4540, rec reply, send msg	Select 4540, rec reply, send msg rec msg	Send last block	Send msg, rec reply, rec msg	Cause 4540 to re-send reply	Cause 4540 to delay sending	Terminate
Write EOT Write ACK 0/1 Write NAK	•	•	•			•	•					
Write RVI Write Select Seq. Write Poll Seq.	•				•	•	•					
Read ENQ Read reply Write WACK						•	•				•	
Write ENQ Read EOT/msg [block] Write message	•	•	•			•	•	•	•	•		
Read reply Read message Write EOT						•	• • •	• • •	• • •	• • •	•	•
Read ENQ Read EOT				•	•							

...Replies & Responses

Computer			
① Sends	② Rec's	③ Sends	④ Rec's
Gen'l or Specific Poll Sequence	Msg/Msg block end'g in ETX/ETB BCC(s)	ACK 0/1* BCC(s) good	next ② msg/msg block
			EOT ①
		NAK BCC(s) bad†	msg/msg block again ②
		EOT BCC(s) bad again ①	
		RVI can't rec more	EOT ①
		Write/Ctrl Cmd Msg ⑤ if BCC(s)good	
		reply not rec'd by 4540	ENQ ③
	EOT	next poll ①	
	no/bad reply	Poll again ①	
	no/bad reply again	EOT ①	
Select Sequence	ACK 0 4540 rdy to rec	Write/Ctrl Cmd Msg ⑤	
		Read Cmd Msg ⑤	
	WACK 4540 bsy	EOT ①	
	RVI has s & s	Spec Poll ①	
	no/bad reply	Select again ①	
	no/bad reply again	EOT ①	

Computer		
⑤ Sends	⑥ Rec's	⑦ Sends
Write/Ctrl Cmd Msg/Msg block end'g in ETX/ETB BCC(s)	ACK 0/1* BCC(s) good	EOT ①
		next ⑤ msg/msg block
		Read Cmd Msg ⑤
	WACK BCC(s) good but can't rec more, bsy ptg msg/block	EOT ①
	NAK BCC bad †	msg/msg block again ⑤
	NAK again	EOT ①
	EOT has s & s	Spec Poll ①
	no/bad reply	ENQ ⑥
	no/bad reply again	EOT ①
Read Cmd Msg end'g in ETX BCC	Msg/Msg ② † block	③ but not to ⑤†
	NAK BCC(s) bad†	Read Cmd Msg again ⑤
	EOT has s & s	Spec Poll ①
	no/bad reply	ENQ ⑥
	no/bad reply again	EOT ①

Tables adjacent show automatic responses generated by 4540 and typically generated by computer. Situations not included require manual intervention and/or error recovery routine.

Replies as shown except where code dependent as indicated in table below.

Reply	Actual Character(s) ASCII	EBCDIC
ACK 0	D L E 0	D L E Hex 70
ACK 1	D L E 1	D L E /
WACK	D L E ;	D L E ,
RVI	D L E <	D L E @
NAK	N A K	N A K

*Reply alternates between ACK 0 & ACK 1 for successive blocks &/or messages, beginning with ACK 1.

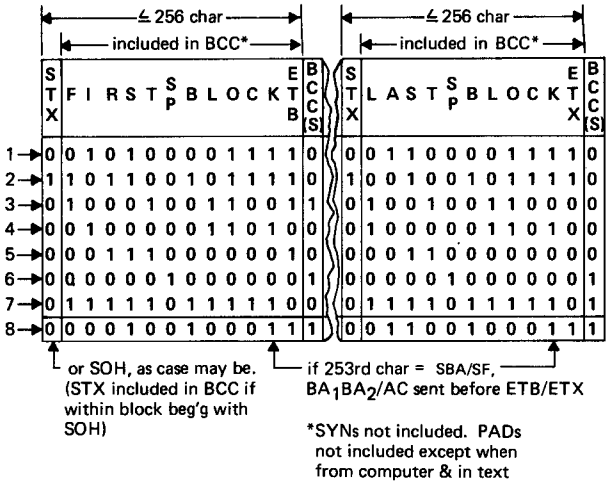
†Possible replies to received message or message block same as for specific poll except remove the Write/Control Command message possibility from column 3 (because only one two-way message or block transfer is permitted without an intervening ACK).

†or message or block contains ENQ (or parity error in any character if ASCII).

MESSAGE BLOCKING

Occurs if message is to computer and is greater than 252 chars. May also occur on messages from computer.

Each block begins with STX (1st may begin with SOH) & ends with ETB BCC(s) (last ends with ETX BCC(s). BCC(s) halt transmission & require reply per table on page 7. 1 BCC for ASCII, 2 for EBCDIC.



*SYNs not included. PADs not included except when from computer & in text

ASCII Code

Each BCC bit = 1/0 according to whether the number of 1 bits in the corresponding row for the characters included in the block is odd/even, respectively.

Each character's 8th (parity) bit = 1/0 according to whether the number of 1 bits in the char is even/odd, respectively.

EBCDIC Code

The BCCs are constructed according to CRC. That is, the BCCs (taken together) are the binary equivalent of the number that is the remainder left from dividing the numeric binary value of the characters in the block by a constant.

SYNCHRONIZATION

All Transmissions to the computer begin with 4 SYNs (01101000 if ASCII, 00110010 if EBCDIC) (bits 1 to 8 & 0 to 7, respectively) and end with 1 PAD (11111111).

All transmissions from the computer must begin with at least 2 SYNs and end with 1 PAD (which can be 11111111 or 11111110). Also, 2 SYNs are automatically sent once each second during transmission to or from the computer.

EOT is treated as a transmission in itself, even when followed by other characters. Therefor 2 SYNs and 1 PAD precede and follow EOT and precede and follow the characters that follow EOT.

ESTABLISHMENT OF COMMUNICATIONS

	Control Sequences (from computer)		Reply Sequences (from 4540)
	type	character	type
4540 to Send	General* Poll	EOT SPA SPA " " ENQ	Msg rdy to send†
	Specific Poll	EOT SPA SPA DA DA ENQ	EOT not rdy to send†
4540 to Receive	Selection	EOT SSA SSA DA DA ENQ	ACK 0 rdy to rec
			WACK not rdy to rec, busy
			RVI not rdy to rec. Poll for status msg

*lowest numbered device sends 1st unless a higher numbered has not taken its turn.

†Applies equally to general and specific poll.

MESSAGE TRANSFER—4540 SENDS

Message	
type	character sequence
Rd Mod'd† (S/R or PF key depressed or badge inserted in MSBR)‡	STX SPA DAD AID C A1 C A2 SBA▼ A A1 A2 data in field (less NULs)* ETX CBC
Short Read† (PA or CLEAR key depressed)	STX SPA DAD AID ETX CBC
Rmte Test Rqst† (R/TST key depressed)	SOH 0 % / TX S TBA▼ A A1 A2 data in field (less NULs)* ETX CBC
Read All (in reply to read all cmd)	STX SPA DAD AID C A1 C A2 SF▼ A C data in field (plus NULs)** ETX CBC
Status (in reply to poll if S&S) Takes priority over other msgs	SOH 0 % R TX S TPA DA S S1 S2 ETX CBC

†sent in reply to poll or read modified command
*if no fields, data in buffer (less NULs) sent
**if no fields data in buffer (plus NULs) sent
‡also sent in reply to Read Modified Command if no key depressed

▼ SBA = DC1 & SF = GS if ASCII

Key Depressed	AID
S/R	'
PA1	%
PA2	>
PA3	,
R/TST	0
PF1	1
PF2	2
PF3	3
PF4	4
PF5	5
PF6	6
PF7	7
PF8	8
PF9	9
PF10	:
PF11	#
PF12	@
CLEAR	_
none, KD	-
none, P	Y
Badge entered	W

Status & Sense (S&S) (Sent only in reply to specific poll, except as noted)			S S1	S S2
Bad Command or Order	ESC missing		SP	A
	ETX out of place			
	contains invalid BA or DA			
	contains invalid ESC sequence		SP	—
Device Busy	being copied		H	A
	other reason		H	SP
	no longer		B	S† P
Device Not Available	to be copied	buffer locked	D	A
		other reason	SP	J
	printer paper out or cover up		B	&†
	other reason		SP	&
	now available		B	S† P
Data Transfer Aborted	during copy between devices		SP	C
	device fails to send next char on request from CC		SP	D†
	device fails to request next char from CC		SP	B†
	device fails to send			
	CC buffer overflowed			

†sent in reply to general as well as specific poll
‡sent only following prior selection, in reply to general as well as specific poll

MESSAGE TRANSFER—4540 RECEIVES

Write Command Message			
STX	write or erase-write command	data and/or orders	ETX BCC (S)
Read/Control Command Message			
STX	erase all unprotected, copy, read modified or read all command		ETX BCC (S)

Command	
Write	ESC 1 WCC
Erase-Write	ESC 5 WCC
Erase All Unprotected	ESC ?
Copy	ESC 7 CCC D* A
Read Modified	ESC 6
Read All	ESC 2

Order		ASCII	EBCDIC	
SBA	Set Buffer Address	DC1	SBA	B B A_1 A_2
SF	Start Field	GS	SF	A C
IC	Insert Cursor	DC3	IC	
PT	Program Tab	HT	PT	
RA	Repeat to Address	DC4	RA	B B C A_1 A_2
EUA	Erase Unprotected to Address	DC2	EUA	B B A_1 A_2

*Copying and copied device must share same CC.
Copying and copied device can be the same device.

Bit	Specify Field as: Protected‡	Numeric	Hidden	Highlighted*	Modified	AC
	2=1	3=1	4,5=1,1	4,5=1,0	7=1	option 403a or b
Autoskip						SP
					•	A
				•		H
				•	•	I
			•			<
			•		•	(
		•				&
		•			•	J
		•		•		Q
		•		•	•	R
		•	•			*
		•	•		•	)
	•					-
	•				•	/
	•			•		Y
	•			•	•	Z
	•		•			%
	•		•		•	_
	•	•				0
	•	•			•	1
	•	•		•		8
	•	•		•	•	9
	•	•	•			@
	•	•	•		•	'

Bit	Specify Field as: Protected‡	Numeric	Hidden	Highlighted: Blinked†	Highlighted: Intensified†	Modified	AC
	2=1	3=1	4,5=1,1	4,5,6=1,0,1	4,5,6=1,0,0	7=1	option 403c†
Autoskip							SP
						•	A
					•		H
					•	•	I
				•			[¢
				•		•	.
			•				<
			•			•	(
		•					&
		•				•	J
		•			•		Q
		•			•	•	R
		•	•				] !
		•	•			•	$
		•	•				*
		•	•			•	)
	•						-
	•					•	/
	•				•		Y
	•				•	•	Z
	•			•			¦
	•			•		•	,
	•		•				%
	•		•			•	_
	•	•					0
	•	•				•	1
	•	•			•		8
	•	•			•	•	9
	•	•		•			:
	•	•		•		•	#
	•	•	•				@
	•	•	•			•	'

Bit	WCC† Start Printer	Sound KD Tone	Put KD in LOCAL	Reset ACs to Unmodified	Print: NL char/line	40 char/line	64 char/line	80 char/line
	4=1	5=1	6=1	7=1	2,3=0,0	2,3=0,1	2,3=1,0	2,3=1,1
					SP	&	-	0
				•	A	J	/	1
			•		B	K	S	2
			•	•	C	L	T	3
		•			D	M	U	4
		•		•	E	N	V	5
		•	•		F	O	W	6
		•	•	•	G	P	X	7
	•				H	Q	Y	8
	•			•	I	R	Z	9
	•		•		[¢	] !	¦	:
	•		•	•	.	$	,	#
	•	•			<	*	%	@
	•	•		•	(	)	_	'
	•	•	•		+	;	>	=
	•	•	•	•	! ¦	^ ¬	?	"

Bit	CCC† Start Printer	Sound KD Tone	Copy: ACs	Protected Data 6,7=1,0	Unprotected Data 6,7=0,1	Print: NL char/line	40 char/line	64 char/line	80 char/line
	4=1	5=1	6,7=0,0	6,7=1,1		2,3=0,0	2,3=0,1	2,3=1,0	2,3=1,1
			•			SP	&	-	0
			•		•	A	J	/	1
			•	•		B	K	S	2
			•	•	•	C	L	T	3
		•	•			D	M	U	4
		•	•		•	E	N	V	5
		•	•	•		F	O	W	6
		•	•	•	•	G	P	X	7
	•		•			H	Q	Y	8
	•		•		•	I	R	Z	9
	•		•	•		[¢	] !	¦	:
	•		•	•	•	.	$	,	#
	•	•	•			<	*	%	@
	•	•	•		•	(	)	_	'
	•	•	•	•		+	;	>	=
	•	•	•	•	•	! ¦	^ ¬	?	"

†device ignores [portions of] commands it cannot perform; without causing a status message to be generated. Where 2 characters shown, ASCII on left, EBCDIC on right.

*Highlighted fields are intensified or blinked, according to whether option 403a or 403b is elected respectively.

†Fields specified as blinked cause fields specified as intensified to be blinked if displayed at the same time on the same display.

‡A protected numeric AC causes auto-skip. A protected alphanumeric AC at BA_1 BA_2 = SP SP (home) location prevents both PRINT LOCAL & copy command print-out.

Where 2 characters are shown, the left-hand is ASCII, the right EBCDIC.

BUFFER ADDRESSES

A A
A_1 A_2 B B
A_1 A_2 C C
A_1 A_2

	Columns 1–16															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Row 1	SS PP	S_PA	S_PB	S_PC	S_PD	S_PE	S_PF	S_PG	S_PH	S_PI	S_P[	S_P.	S_P<	S_P(	S_P+	S_P!
Row 2	A&	AJ	AK	AL	AM	AN	AO	AP	AQ	AR	A]	A$	A*	A)	A;	A^
Row 3	B-	B/	BS	BT	BU	BV	BW	BX	BY	BZ	B¦	B,	B%	B_	B>	B?
Row 4	C0	C1	C2	C3	C4	C5	C6	C7	C8	C9	C:	C#	C@	C'	C=	C"
Row 5	E_P^S	EA	EB	EC	ED	EE	EF	EG	EH	EI	E[	E.	E<	E(	E+	E!
Row 6	F&	FJ	FK	FL	FM	FN	FO	FP	FQ	FR	F]	F$	F*	F)	F;	F^
Row 7	G-	G/	GS	GT	GU	GV	GW	GX	GY	GZ	G¦	G,	G%	G_	G>	G?
Row 8	H0	H1	H2	H3	H4	H5	H6	H7	H8	H9	H:	H#	H@	H'	H=	H"
Row 9	$[_P^S$	[A	[B	[C	[D	[E	[F	[G	[H	[I	[[	[.	[<	[(	[+	[!
Row 10	.&	.J	.K	.L	.M	.N	.O	.P	.Q	.R	.]	.$	.*	.)	.;	.^
Row 11	<-	</	<S	<T	<U	<V	<W	<X	<Y	<Z	<¦	<,	<%	<_	<>	<?
Row 12	(0	(1	(2	(3	(4	(5	(6	(7	(8	(9	(:	(#	(@	('	(=	("
Row 13	$!_P^S$	!A	!B	!C	!D	!E	!F	!G	!H	!I	![	!.	!<	!(	!+	!!
Row 14	&&	&J	&K	&L	&M	&N	&O	&P	&Q	&R	&]	&$	&*	&)	&;	&^
Row 15	J-	J/	JS	JT	JU	JV	JW	JX	JY	JZ	J¦	J,	J%	J_	J>	J?
Row 16	K0	K1	K2	K3	K4	K5	K6	K7	K8	K9	K:	K#	K@	K'	K=	K"
Row 17	M_P^S	MA	MB	MC	MD	ME	MF	MG	MH	MI	M[	M.	M<	M(	M+	M!
Row 18	N&	NJ	NK	NL	NM	NN	NO	NP	NQ	NR	N]	N$	N*	N)	N;	N^
Row 19	O-	O/	OS	OT	OU	OV	OW	OX	OY	OZ	O¦	O,	O%	O_	O>	O?
Row 20	P0	P1	P2	P3	P4	P5	P6	P7	P8	P9	P:	P#	P@	P'	P=	P"
Row 21	R_P^S	RA	RB	RC	RD	RE	RF	RG	RH	RI	R[	R.	R<	R(	R+	R!
Row 22	]&	]J	]K	]L	]M	]N	]O	]P	]Q	]R	]]	]$	]*	])	];	]^
Row 23	$-	$/	$S	$T	$U	$V	$W	$X	$Y	$Z	$¦	$,	$%	$_	$>	$?
Row 24	*0	*1	*2	*3	*4	*5	*6	*7	*8	*9	*:	*#	*@	*'	*=	*"

	Columns 17–32															
	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Row 1	S_P&	S_PJ	S_PK	S_PL	S_PM	S_PN	S_PO	S_PP	S_PQ	S_PR	S_P]	$S_P$$	S_P*	S_P)	S_P;	S_P^
Row 2	A-	A/	AS	AT	AU	AV	AW	AX	AY	AZ	A¦	A,	A%	A_	A>	A?
Row 3	B0	B1	B2	B3	B4	B5	B6	B7	B8	B9	B:	B#	B@	B'	B=	B"
Row 4	D_P^S	DA	DB	DC	DD	DE	DF	DG	DH	DI	D[	D.	D<	D(	D+	D!
Row 5	E&	EJ	EK	EL	EM	EN	EO	EP	EQ	ER	E]	E$	E*	E)	E;	E^
Row 6	F-	F/	FS	FT	FU	FV	FW	FX	FY	FZ	F¦	F,	F%	F_	F>	F?
Row 7	G0	G1	G2	G3	G4	G5	G6	G7	G8	G9	G:	G#	G@	G'	G=	G"
Row 8	I_P^S	IA	IB	IC	ID	IE	IF	IG	IH	II	I[	I.	I<	I(	I+	I!
Row 9	[&	[J	[K	[L	[M	[N	[O	[P	[Q	[R	[]	[$	[*	[)	[;	[^
Row 10	.-	./	.S	.T	.U	.V	.W	.X	.Y	.Z	.¦	.,	.%	.-	.>	.?
Row 11	<0	<1	<2	<3	<4	<5	<6	<7	<8	<9	<:	<#	<@	<'	<=	<"
Row 12	$+_P^S$	+A	+B	+C	+D	+E	+F	+G	+H	+I	+[	+.	+<	+(	++	+!
Row 13	!&	!J	!K	!L	!M	!N	!O	!P	!Q	!R	!]	!$	!*	!)	!;	!^
Row 14	&-	&/	&S	&T	&U	&V	&W	&X	&Y	&Z	&¦	&,	&%	&_	&>	&?
Row 15	J0	J1	J2	J3	J4	J5	J6	J7	J8	J9	J:	J#	J@	J'	J=	J"
Row 16	L_P^S	LA	LB	LC	LD	LE	LF	LG	LH	LI	L[	L.	L<	L(	L+	L!
Row 17	M&	MJ	MK	ML	MM	MN	MO	MP	MQ	MR	M]	M$	M*	M)	M;	M^
Row 18	N-	N/	NS	NT	NU	NV	NW	NX	NY	NZ	N¦	N,	N%	N_	N>	N?
Row 19	O0	O1	O2	O3	O4	O5	O6	O7	O8	O9	O:	O#	O@	O'	O=	O"
Row 20	Q_P^S	QA	QB	QC	QD	QE	QF	QG	QH	QI	Q[	Q.	Q<	Q(	Q+	Q!
Row 21	R&	RJ	RK	RL	RM	RN	RO	RP	RQ	RR	R]	R$	R*	R)	R;	R^
Row 22	]-	]/	]S	]T	]U	]V	]W	]X	]Y	]Z	]¦	],	]%	]_	]>	]?
Row 23	$0	$1	$2	$3	$4	$5	$6	$7	$8	$9	$:	$#	$@	$'	$=	$"
Row 24	$)_P^S$	)A	)B	)C	)D	)E	)F	)G	)H	)I	)[	).	)<	)(	)+	)!

	Columns 33–48															
	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
Row 1	S_P-	S_P/	S_PS	S_PT	S_PU	S_PV	S_PW	S_PX	S_PY	S_PZ	S_P¦	S_P,	S_P%	S_P_	S_P>	S_P?
Row 2	A0	A1	A2	A3	A4	A5	A6	A7	A8	A9	A:	A#	A@	A'	A=	A"
Row 3	C_P^S	CA	CB	CC	CD	CE	CF	CG	CH	CI	C[	C.	C<	C(	C+	C!
Row 4	D&	DJ	DK	DL	DM	DN	DO	DP	DQ	DR	D]	D$	D*	D)	D;	D^
Row 5	E-	E/	ES	ET	EU	EV	EW	EX	EY	EZ	E¦	E,	E%	E_	E>	E?
Row 6	F0	F1	F2	F3	F4	F5	F6	F7	F8	F9	F:	F#	F@	F'	F=	F"
Row 7	H_P^S	HA	HB	HC	HD	HE	HF	HG	HH	HI	H[	H.	H<	H(	H+	H!
Row 8	I&	IJ	IK	IL	IM	IN	IO	IP	IQ	IR	I]	I$	I*	I)	I;	I^
Row 9	[-	[/	[S	[T	[U	[V	[W	[X	[Y	[Z	[¦	[,	[%	[_	[>	[?
Row 10	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9	.:	.#	.@	.'	.=	."
Row 11	$(_P^S$	(A	(B	(C	(D	(E	(F	(G	(H	(I	([	(.	(<	((	(+	(!
Row 12	+&	+J	+K	+L	+M	+N	+O	+P	+Q	+R	+]	+$	+*	+)	+;	+^
Row 13	!-	!/	!S	!T	!U	!V	!W	!X	!Y	!Z	!¦	!,	!%	!_	!>	!?
Row 14	&0	&1	&2	&3	&4	&5	&6	&7	&8	&9	&:	&#	&@	&'	&=	&"
Row 15	K_P^S	KA	KB	KC	KD	KE	KF	KG	KH	KI	K[	K.	K<	K(	K+	K!
Row 16	L&	LJ	LK	LL	LM	LN	LO	LP	LQ	LR	L]	L$	L*	L)	L;	L^
Row 17	M-	M/	MS	MT	MU	MV	MW	MX	MY	MZ	M¦	M,	M%	M_	M>	M?
Row 18	N0	N1	N2	N3	N4	N5	N6	N7	N8	N9	N:	N#	N@	N'	N=	N"
Row 19	P_P^S	PA	PB	PC	PD	PE	PF	PG	PH	PI	P[	P.	P<	P(	P+	P!
Row 20	Q&	QJ	QK	QL	QM	QN	QO	QP	QQ	QR	Q]	Q$	Q*	Q)	Q;	Q^
Row 21	R-	R/	RS	RT	RU	RV	RW	RX	RY	RZ	R¦	R,	R%	R_	R>	R?
Row 22	]0	]1	]2	]3	]4	]5	]6	]7	]8	]9	]:	]#	]@	]'	]=	]"
Row 23	$*_P^S$	*A	*B	*C	*D	*E	*F	*G	*H	*I	*[	*.	*<	*(	*+	*!
Row 24	)&	)J	)K	)L	)M	)N	)O	)P	)Q	)R	)]	)$	)*	))	);	)^

If EBCDIC: replace ASCII characters shown above per table adjacent

ASCII	[	!	]	^
EBCDIC	¢	|	!	¬

BUFFER ADDRESSES (Continued)

A A A_1 A_2 B B A_1 A_2 C C A_1 A_2

	Columns 49–64															
	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64
Row 1	S_P0	S_P1	S_P2	S_P3	S_P4	S_P5	S_P6	S_P7	S_P8	S_P9	S_P:	S_P#	S_P@	S_P'	S_P=	S_P"
Row 2	B_P^S	BA	BB	BC	BD	BE	BF	BG	BH	BI	B[	B.	B<	B(	B+	B!
Row 3	C&	CJ	CK	CL	CM	CN	CO	CP	CQ	CR	C]	C$	C*	C)	C;	C^
Row 4	D-	D/	DS	DT	DU	DV	DW	DX	DY	DZ	D¦	D,	D%	D_	D>	D?
Row 5	E0	E1	E2	E3	E4	E5	E6	E7	E8	E9	E:	E#	E@	E'	E=	E"
Row 6	G_P^S	GA	GB	GC	GD	GE	GF	GG	GH	GI	G[	G.	G<	G(	G+	G!
Row 7	H&	HJ	HK	HL	HM	HN	HO	HP	HQ	HR	H]	H$	H*	H)	H;	H^
Row 8	I-	I/	IS	IT	IU	IV	IW	IX	IY	IZ	I¦	I,	I%	I_	I>	I?
Row 9	[0	[1	[2	[3	[4	[5	[6	[7	[8	[9	[:	[#	[@	('	[=	["
Row 10	$<_P^S$	<A	<B	<C	<D	<E	<F	<G	<H	<I	<¦	<.	<<	<(	<+	<!
Row 11	(&	(J	(K	(L	(M	(N	(O	(P	(Q	(R	(]	($	(*	()	(;	(^
Row 12	+-	+/	+S	+T	+U	+V	+W	+X	+Y	+Z	+¦	+,	+%	+_	+>	+?
Row 13	!0	!1	!2	!3	!4	!5	!6	!7	!8	!9	!:	!#	!@	!'	!=	!"
How 14	J_P^S	JA	JB	JC	JD	JE	JF	JG	JH	JI	J[	J.	J<	J(	J+	J!
Row 15	K&	KJ	KK	KL	KM	KN	KO	KP	KQ	KR	K]	K$	K*	K)	K;	K^
Row 16	L-	L/	LS	LT	LU	LV	LW	LX	LY	LZ	L¦	L,	L%	L_	L>	L?
Row 17	M0	M1	M2	M3	M4	M5	M6	M7	M8	M9	M:	M#	M@	M'	M=	M"
Row 18	O_P^S	OA	OB	OC	OD	OE	OF	OG	OH	OI	O[	O.	O<	O(	O+	O!
Row 19	P&	PJ	PK	PL	PM	PN	PO	PP	PQ	PR	P]	P$	P*	P)	P;	P^
Row 20	Q-	Q/	QS	QT	QU	QV	QW	QX	QY	QZ	Q¦	Q,	Q%	Q_	Q>	Q?
Row 21	R0	R1	R2	R3	R4	R5	R6	R7	R8	R9	R:	R#	R@	R'	R=	R"
Row 22	$\$_P^S$	$A	$B	$C	$D	$E	$F	$G	$H	$I	$[	$.	$<	$(	$+	$!
Row 23	*&	*J	*K	*L	*M	*N	*O	*P	*Q	*R	*]	*$	**	*)	*;	*^
Row 24	)-	)/	)S	)T	)U	)V	)W	)X	)Y	)Z	)¦	),	)%	)_	)>	)?

	Columns 65–80															
	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
Row 1	A_P^S	AA	AB	AC	AD	AE	AF	AG	AH	AI	A[	A.	A<	A(	A+	A!
Row 2	B&	BJ	BK	BL	BM	BN	BO	BP	BQ	BR	B]	B$	B*	B)	B;	B^
Row 3	C-	C/	CS	CT	CU	CV	CW	CX	CY	CZ	C¦	C,	C%	C_	C>	C?
Row 4	D0	D1	D2	D3	D4	D5	D6	D7	D8	D9	D:	D#	D@	D'	D=	D"
Row 5	F_P^S	FA	FB	FC	FD	FE	FF	FG	FH	FI	F[	F.	F<	F(	F+	F!
Row 6	G&	GJ	GK	GL	GM	GN	GO	GP	GQ	GR	G]	G$	G*	G)	G;	G^
Row 7	H-	H/	HS	HT	HU	HV	HW	HX	HY	HZ	H¦	H,	H%	H_	H>	H?
Row 8	I0	I1	I2	I3	I4	I5	I6	I7	I8	I9	I:	I#	I@	I'	I=	I"
Row 9	$._P^S$	.A	.B	.C	.D	.E	.F	.G	.H	.I	.[	..	.<	.(	.+	.!
Row 10	<&	<J	<K	<L	<M	<N	<O	<P	<Q	<R	<]	<$	<*	<)	<;	<^
Row 11	(-	(/	(S	(T	(U	(V	(W	(X	(Y	(Z	(¦	(,	(%	(_	(>	(?
Row 12	+0	+1	+2	+3	+4	+5	+6	+7	+8	+9	+:	+#	+@	+'	+=	+"
Row 13	$\&_P^S$	&A	&B	&C	&D	&E	&F	&G	&H	&I	&[	&.	&<	&(	&+	&!
Row 14	J&	JJ	JK	JL	JM	JN	JO	JP	JQ	JR	J]	J$	J*	J)	J;	J^
Row 15	K-	K/	KS	KT	KU	KV	KW	KX	KY	KZ	K¦	K,	K%	K_	K>	K?
Row 16	L0	L1	L2	L3	L4	L5	L6	L7	L8	L9	L:	L#	L@	L'	L=	L"
Row 17	N_P^S	NA	NB	NC	ND	NE	NF	NG	NH	NI	N[	N.	N<	N(	N+	N!
Row 18	O&	OJ	OK	OL	OM	ON	OO	OP	OQ	OR	O]	O$	O*	O)	O;	O^
Row 19	P-	P/	PS	PT	PU	PV	PW	PX	PY	PZ	P¦	P,	P%	P_	P>	P?
Row 20	Q0	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q:	Q#	Q@	Q'	Q=	Q"
Row 21	$]_P^S$	]A	]B	]C	]D	]E	]F	]G	]H	]I	][	].	]<	](	]+	]!
Row 22	$&	$J	$K	$L	$M	$N	$O	$P	$Q	$R	$]	$$	$*	$)	$;	$^
Row 23	*-	*/	*S	*T	*U	*V	*W	*X	*Y	*Z	*¦	*,	*%	*_	*>	*?
Row 24	)0	)1	)2	)3	)4	)5	)6	)7	)8	)9	):	)#	)@	)'	)=	)"

If EBCDIC: replace ASCII characters shown above per table adjacent

ASCII	[	!	]	^
EBCDIC	¢	|	!	¬

ASCII CODE WITH ODD PARITY

(Bits are sent in sequence 1 through 8)

	Binary Bits 87654321	ASCII Hex 7654321	ASCII Hex 12345678	EBCDIC Hex 01234567		Binary Bits 87654321	ASCII Hex 7654321	ASCII Hex 12345678	EBCDIC Hex 01234567
NUL	10000000	00	80	00	@	01000000	40	40	7C
SOH	00000001	01	01	01	A	11000001	41	C1	C1
STX	00000010	02	02	02	B	11000010	42	C2	C2
ETX	10000011	03	83	03	C	01000011	43	43	C3
EOT	00000100	04	04	37	D	11000100	44	C4	C4
ENQ	10000101	05	85	2D	E	01000101	45	45	C5
ACK	10000110	06	86	2E	F	01000110	46	46	C6
BEL	00000111	07	07	2F	G	11000111	47	C7	C7
BS	00001000	08	08	16	H	11001000	48	C8	C8
HT	10001001	09	89	05	I	01001001	49	49	C9
NL	10001010	0A	8A	15	J	01001010	4A	4A	D1
VT	00001011	0B	0B	0B	K	11001011	4B	CB	D2
FF	10001100	0C	8C	0C	L	01001100	4C	4C	D3
CR	00001101	0D	0D	0D	M	11001101	4D	CD	D4
SO	00001110	0E	0E	0E	N	11001110	4E	CE	D5
SI	10001111	0F	8F	0F	O	01001111	4F	4F	D6
DLE	00010000	10	10	10	P	11010000	50	D0	D7
DC1	10010001	11	91	11	Q	01010001	51	51	D8
DC2	10010010	12	92	12	R	01010010	52	52	D9
DC3	00010011	13	13	13	S	11010011	53	D3	E2
DC4	10010100	14	94	3C	T	01010100	54	54	E3
NAK	00010101	15	15	3D	U	11010101	55	D5	E4
SYN	00010110	16	16	32	V	11010110	56	D6	E5
ETB	10010111	17	97	26	W	01010111	57	57	E6
CAN	10011000	18	98	18	X	01011000	58	58	E7
EM	00011001	19	19	19	Y	11011001	59	D9	E8
SUB	00011010	1A	1A	3F	Z	11011010	5A	DA	E9
ESC	10011011	1B	9B	27	[	01011011	5B	5B	
FS	00011100	1C	1C	1C	\	11011100	5C	DC	
GS	10011101	1D	9D	1D	]	01011101	5D	5D	
RS	10011110	1E	9E	1E	^	01011110	5E	5E	
US	00011111	1F	1F	1F	_	11011111	5F	DF	6D
SP	00100000	20	20	40	`	11100000	60	E0	
!	10100001	21	A1	5A	a	01100001	61	61	81
"	10100010	22	A2	7F	b	01100010	62	62	82
#	00100011	23	23	7B	c	11100011	63	E3	83
$	10100100	24	A4	5B	d	01100100	64	64	84
%	00100101	25	25	6C	e	11100101	65	E5	85
&	00100110	26	26	50	f	11100110	66	E6	86
'	10100111	27	A7	7D	g	01100111	67	67	87
(	10101000	28	A8	4D	h	01101000	68	68	88
)	00101001	29	29	5D	i	11101001	69	E9	89
*	00101010	2A	2A	5C	j	11101010	6A	EA	91
+	10101011	2B	AB	4E	k	01101011	6B	6B	92
,	00101100	2C	2C	6B	l	11101100	6C	EC	93
-	10101101	2D	AD	60	m	01101101	6D	6D	94
.	10101110	2E	AE	4B	n	01101110	6E	6E	95
/	00101111	2F	2F	61	o	11101111	6F	EF	96
0	10110000	30	B0	F0	p	01110000	70	70	97
1	00110001	31	31	F1	q	11110001	71	F1	98
2	00110010	32	32	F2	r	11110010	72	F2	99
3	10110011	33	B3	F3	s	01110011	73	73	A2
4	00110100	34	34	F4	t	11110100	74	F4	A3
5	10110101	35	B5	F5	u	01110101	75	75	A4
6	10110110	36	B6	F6	v	01110110	76	76	A5
7	00110111	37	37	F7	w	11110111	77	F7	A6
8	00111000	38	38	F8	x	11111000	78	F8	A7
9	10111001	39	B9	F9	y	01111001	79	79	A8
:	10111010	3A	BA	7A	z	01111010	7A	7A	A9
;	00111011	3B	3B	5E	{	11111011	7B	FB	C0
<	10111100	3C	BC	4C	|	01111100	7C	7C	6A
=	00111101	3D	3D	7E	}	11111101	7D	FD	D0
>	00111110	3E	3E	6E	~	11111110	7E	FE	A1
?	10111111	3F	BF	6F	DEL	01111111	7F	7F	07

NUL • Null
SOH • Start of Heading
STX • Start of Text
ETX • End of Text
EOT • End of Trans'n
ENQ • Enquiry
ACK • Acknowledge
BEL • Bell
BS • Back Space
HT • Horizontal Tab
NL • New Line
VT • Vertical Tab
FF = Form Feed
CR = Carriage Return
SO = Shift-Out
SI = Shift-In
DLE = Data Link Escape
DC1 = Device Control 1
DC2 = Device Control 2
DC3 = Device Control 3
DC4 = Device Control 4
NAK = Negative Acknowledge
SYN = Synchronous
ETB = End of Trans'n Block
CAN = Cancel
EM = End of Media
SUB = Substitute
ESC = Escape
FS = Field Separator
GS = Group Separator
RS = Record Separator
US = Unit Separator
SP = Space
DEL = Delete

EBCDIC CODE

(Bits are sent in sequence 7 through 0)

	Binary Bits 01234567	Hex		Binary Bits 01234567	Hex		Binary Bits 01234567	Hex		Binary Bits 01234567	Hex
NUL	00000000	00	SP	01000000	40		10000000	80	{	11000000	C0
SOH	00000001	01		01000001	41	a	10000001	81	A	11000001	C1
STX	00000010	02		01000010	42	b	10000010	82	B	11000010	C2
ETX	00000011	03		01000011	43	c	10000011	83	C	11000011	C3
	00000100	04		01000100	44	d	10000100	84	D	11000100	C4
PT	00000101	05		01000101	45	e	10000101	85	E	11000101	C5
	00000110	06		01000110	46	f	10000110	86	F	11000110	C6
	00000111	07		01000111	47	g	10000111	87	G	11000111	C7
	00001000	08		01001000	48	h	10001000	88	H	11001000	C8
	00001001	09		01001001	49	i	10001001	89	I	11001001	C9
	00001010	0A	¢	01001010	4A		10001010	8A		11001010	CA
	00001011	0B	.	01001011	4B		10001011	8B		11001011	CB
FF	00001100	0C	<	01001100	4C		10001100	8C		11001100	CC
	00001101	0D	(	01001101	4D		10001101	8D		11001101	CD
	00001110	0E	+	01001110	4E		10001110	8E		11001110	CE
	00001111	0F	!	01001111	4F		10001111	8F		11001111	CF
DLE	00010000	10	&	01010000	50		10010000	90	}	11010000	D0
SBA	00010001	11		01010001	51	j	10010001	91	J	11010001	D1
EUA	00010010	12		01010010	52	k	10010010	92	K	11010010	D2
IC	00010011	13		01010011	53	l	10010011	93	L	11010011	D3
	00010100	14		01010100	54	m	10010100	94	M	11010100	D4
NL	00010101	15		01010101	55	n	10010101	95	N	11010101	D5
	00010110	16		01010110	56	o	10010110	96	O	11010110	D6
	00010111	17		01010111	57	p	10010111	97	P	11010111	D7
	00011000	18		01011000	58	q	10011000	98	Q	11011000	D8
EM	00011001	19		01011001	59	r	10011001	99	R	11011001	D9
	00011010	1A	!	01011010	5A		10011010	9A		11011010	DA
	00011011	1B	$	01011011	5B		10011011	9B		11011011	DB
DUP	00011100	1C	*	01011100	5C		10011100	9C		11011100	DC
SF	00011101	1D	)	01011101	5D		10011101	9D		11011101	DD
FM	00011110	1E	;	01011110	5E		10011110	9E		11011110	DE
ITB	00011111	1F	¬	01011111	5F		10011111	9F		11011111	DF
	00100000	20	-	01100000	60		10100000	A0	\	11100000	E0
	00100001	21	/	01100001	61	~	10100001	A1		11100001	E1
	00100010	22		01100010	62	s	10100010	A2	S	11100010	E2
	00100011	23		01100011	63	t	10100011	A3	T	11100011	E3
	00100100	24		01100100	64	u	10100100	A4	U	11100100	E4
	00100101	25		01100101	65	v	10100101	A5	V	11100101	E5
ETB	00100110	26		01100110	66	w	10100110	A6	W	11100110	E6
ESC	00100111	27		01100111	67	x	10100111	A7	X	11100111	E7
	00101000	28		01101000	68	y	10101000	A8	Y	11101000	E8
	00101001	29		01101001	69	z	10101001	A9	Z	11101001	E9
	00101010	2A	¦	01101010	6A		10101010	AA		11101010	EA
	00101011	2B	,	01101011	6B		10101011	AB		11101011	EB
	00101100	2C	%	01101100	6C		10101100	AC		11101100	EC
ENQ	00101101	2D	—	01101101	6D		10101101	AD		11101101	ED
	00101110	2E	>	01101110	6E		10101110	AE		11101110	EE
	00101111	2F	?	01101111	6F		10101111	AF		11101111	EF
	00110000	30		01110000	70		10110000	B0	0	11110000	F0
	00110001	31		01110001	71		10110001	B1	1	11110001	F1
SYN	00110010	32		01110010	72		10110010	B2	2	11110010	F2
	00110011	33		01110011	73		10110011	B3	3	11110011	F3
	00110100	34		01110100	74		10110100	B4	4	11110100	F4
	00110101	35		01110101	75		10110101	B5	5	11110101	F5
	00110110	36		01110110	76		10110110	B6	6	11110110	F6
EOT	00110111	37		01110111	77		10110111	B7	7	11110111	F7
	00111000	38		01111000	78		10111000	B8	8	11111000	F8
	00111001	39	`	01111001	79		10111001	B9	9	11111001	F9
	00111010	3A	:	01111010	7A		10111010	BA		11111010	FA
	00111011	3B	#	01111011	7B		10111011	BB		11111011	FB
RA	00111100	3C	@	01111100	7C		10111100	BC		11111100	FC
NAK	00111101	3D	'	01111101	7D		10111101	BD		11111101	FB
	00111110	3E	=	01111110	7E		10111110	BE		11111110	FE
SUB	00111111	3F	"	01111111	7F		10111111	BF		11111111	FF

DLE = Data Link Escape
DUP = Duplicate
EM = End of Medium
ENQ = Enquiry
EOT = End of Transmission
ESC = Escape
ETB = End of Transmission Block
ETX = End of Text
EUA = Erase Unprotected to Address
FF = Form Feed
FM = Field Mark
IC = Insert Cursor
ITB = End of Intermediate Transmission Block
NAK = Negative Acknowledge
NL = New Line
NUL = Null
PT = Program Tab
RA = Repeat to Address
SBA = Set Buffer Address
SF = Start Field
SOH = Start of Heading
SP = Space
STX = Start of Text
SUB = Substitute
SYN = Synchronous Idle

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