

TEKTRONIX®

PLOT 10

4010A06

**GRAPHICS TABLET
UTILITY ROUTINES**

USER MANUAL

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SECTION 1

INTRODUCTION

1.0 The Graphics Tablet Utility Routines provide an easy way of using the TEKTRONIX 4953 and 4954 Graphics Tablet in conjunction with a 4010 series Computer Display Terminal and a host computer. The software support consists of six FORTRAN IV subroutines, designed to be used with the Terminal Control System.

~~TABIT~~

~~TABINT~~ - initializes the software system.

ONEPNT - returns the XY coordinates of a single point on the Graphics Tablet to the user.

MULPNT - returns a properly formatted array of X and Y coordinates on the Graphics Tablet to the user.

~~TBARM~~

~~TABARM~~ - arms the Graphics Tablet for either single or multiple point input.

~~TBOFF~~

~~TABOFF~~ - disarms the Graphics Tablet.

~~GETPT~~

~~GETPNT~~ - accepts the characters output by the Graphics Tablet and returns the header character and tablet coordinates indicated by the characters.

Most users will need only the first three routines for their applications. The lower level routines may be used, however, to write routines which suit the user's special applications. ONEPNT and MULPNT can serve as examples of how these lower level routines may be used. See the system flow diagram in Figure 1.

This software package allows the user to control four of the five mode options available on the 4953/4954. They are: multiple point or single point entry; pen or presence mode; local display or not; and 10 or 12 bit addressing. The one option which the software does not allow is whether the pen leaving presence disarms the tablet; these routines always cause the tablet to disarm whenever the pen leaves presence. The subroutine TABINT controls the pen/presence mode, local display/no local display, and 10 bit/12 bit addressing options, while the subroutine TABARM controls the single point/multiple point option.

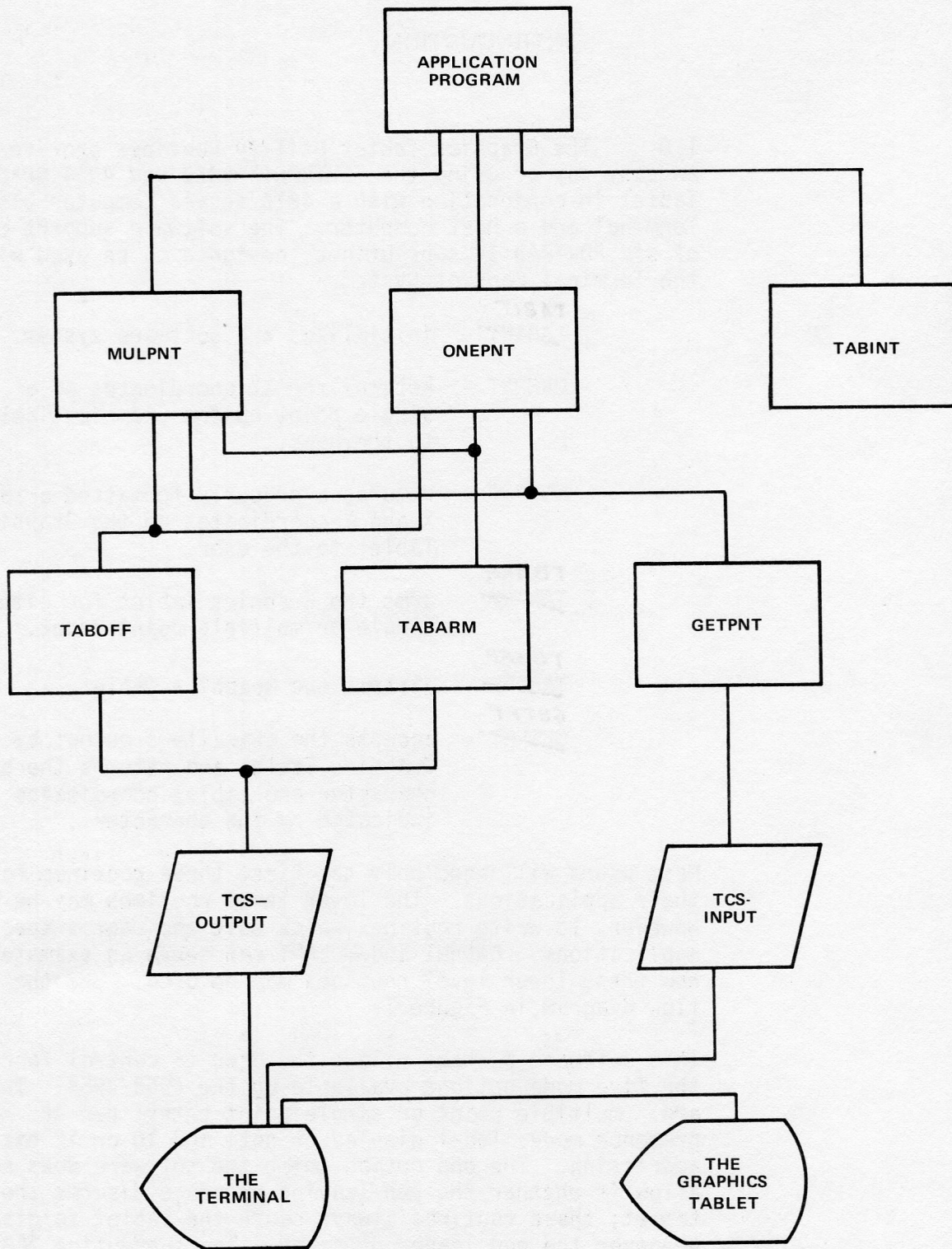


Figure 1
Graphics Tablet Utility Routines

The 4953 and 4954 Graphics Tablets:

1.1 The Graphics Tablet provides the user with an excellent device for inputting graphics data to a computer or other data system. When used with the 4010 series Computer Display Terminal, graphics input and the ability to reference coordinates on the terminal screen become as easy as using a pencil and paper. By sitting at a desk and moving the "writing pen" of the Tablet over a specially designed surface, the Tablet user may enter free-hand graphics, input a message, or draw a chart or picture. The points drawn on the writing surface can be automatically converted into digital positions on the terminal screen, and the points may be stored by the host computer for later reference. The Tablet can send one point at a time or a continuous series of points, depending upon the mode of operation.

Physically, the Graphics Tablet consists of four components. They are:

1. The Tablet

The Tablet, connected to the Power Module, is available in two sizes:

The 4953 Tablet has a flat writing surface with approximately 11 by 11 inches of useable area. It possesses a grid of 1024 by 1024 points, with 100 of these points equaling one inch on the Tablet. This grid corresponds exactly to the addressable screen coordinates on the 4010, 4012, or 4014 Terminal.*

The 4954 Tablet has a flat writing surface with approximately 40 by 30 inches of useable area. It possesses a grid of 4096 by 3120 points. This grid corresponds exactly to the viewable, addressable screen coordinates on the 4014 Terminal with Enhanced Graphics Module (see the 4014 User's Manual). The 4954 Tablet is also compatible with the viewable, addressable screen coordinates (1024 by 780) on the 4010, 4012, and 4014 Terminals.

* 4096 addressing, associated with the 4014 Terminal with the Enhanced Graphics Module, is possible on the 4953 Tablet. The software translates the coordinates into those used for the 4953 (i.e., 1024 addressing).

2. The Writing Implement

This is a pen**, connected to the Power Module, whose tip contains a small electromagnet which enables the Tablet to detect its position on the writing surface, whenever it is in the "presence" of the surface. When in pen mode, the pen must be depressed once for each point sent, whether in single or multiple point mode. When in presence mode, points are digitized and transmitted as fast as the baud rate allows whenever the pen is within 1/4 inch of the writing surface.

3. The Power Module

The Power Module is a box containing some control circuitry for the Tablet and the pen, as well as the ON/OFF switch and power supply for all the components. The three red lights on the front of the box indicate when the circuitry is READY to send points, when the DATA is being digitized and transmitted, and when the PEN is depressed.

4. The Tablet-to-Terminal Interface

This circuit board, inserted into a 4010-Series Terminal, contains most of the control circuitry for the Tablet and pen. The five straps discussed in Appendix A are located here.

** An optional flat cursor with a button which substitutes for pen depression is also available; for the purposes of this manual, however, the implement is assumed to be a writing pen.

SECTION 2

UPPER LEVEL ROUTINES

Tablet Initialization: 2.1 TABINT should always be the first Tablet routine called by the user. It initializes the Graphics Tablet Utility Routines Common area.

Calling Sequence:

~~TABIT~~ (ICoord, LOCDSP, IPEN)

Parameters Entered:

ICoord This argument sets the coordinate system which the user wishes to use*, either 1024 by 1024 or 4096 by 4096. Note that the 4953 tablet addresses all of the points in the above coordinate systems, while the 4954 Tablet addresses coordinate systems of 1024 by 780 points or 4096 by 3120 points:

0 - addresses 1024 space (a range of 0-1023 by 0-1023 points).

1 - addresses 4096 space (a range of 0-4095 by 0-4095 points).

LOCDSP Determines whether points on the Graphics Tablet will be locally displayed on the terminal screen or not:

0 - no local display

1 - local display is generated

IPEN Determines whether the Tablet is armed in pen mode or presence mode:

0 - Pen mode: data is sent each time the pen is depressed.

1 - Presence mode: data is sent whenever the pen is in presence.**

NOTE: (1) Local display should not be generated if the header character strap is set to LETTER. See Appendix A.

(2) Care must be taken when using multiple/presence mode so as not to overrun the system input buffer. (See Examples 4 and 5.)

* The terminal interface must be strapped to indicate whether the Tablet in use is a 4953 or a 4954 for ICoord to work correctly. See Appendix A.

** See the description of the COMSUP strap option in Appendix A.

Multiple Point
Subroutine: MULPNT

2.2 This subroutine arms the Tablet in multiple point mode and accepts data from the Graphics Tablet until either (a) the number of points wanted or more have been entered and the pen has left presence or (b) the user has entered a letter from the keyboard besides J, M or O followed by a CR. (Note: When method (b) is used, the character sent from the keyboard is not returned to the user.) The only points returned by this routine are those with a GS (29) header or a SUB (26) header when no non-SUB header has been received since the last GS was received. This filtering insures that only valid points, sent when the pen is depressed, are returned by this subroutine, and it allows the user to distinguish when the pen leaves and enters presence (See Examples 2 and 4). The user may leave and enter presence with the pen as often as he wishes until the number of valid points specified has been received.

Calling Sequence:

CALL MULPNT (NWNT, NGOT, IH, IX, IY)

Parameter Entered:

NWNT The number of points wanted.

Parameters Returned:

NGOT The number of points returned.

IH An array containing the header characters returned from the Tablet. See Section 3.3 and Appendix A for an explanation of the meanings of the header characters.

IX An array containing the X-coordinates input from the Tablet.

IY An array containing the Y-coordinates input from the Tablet.

Single Point
Subroutine: ONEPNT

2.3 ONEPNT arms the Tablet in single point mode, accepts one valid point (with either a GS (29) or SUB (26) header), and disarms the Tablet. The CR strap (See Appendix A) should be IN when using this routine, but if it is OUT, the user may enter a CR from the keyboard after entering the single point.

Calling Sequence:

CALL ONEPNT (IX, IY)

Parameters Returned:

IX	The Tablet X-coordinate which has been input.
IY	The Tablet Y-coordinate which has been input.

SECTION 3

LOWER LEVEL ROUTINES

Tablet Arming Subroutine: TABARM

3.1 This routine arms the Tablet* using information contained in the Common area of the software in addition to the input parameter, MULT, which specifies single point or multiple point input. This routine is called by subroutines Mulpnt and OnePnt. When the user arms the Tablet with TABARM, he should use TABOFF (see following) after Tablet input is completed.

Calling Sequence:

TBARM (1)
CALL TABARM (MULT)

Parameter Entered:

MULT Arm for multiple or single point input:

0 - arm, input one point, disarm.

1 - arm, input points, disarm when the writing pen leaves presence. Computer echo is not resumed if the Echo Suppression Strap (See Appendix A) is set to IN when the Tablet is disarmed.

Tablet Disarming Subroutine: TABOFF

3.2 This routine disarms the Graphics Tablet and is called by subroutines Mulpnt and OnePnt. If the Tablet interface board is strapped for the suppression of computer echo, the computer echo will be reenabled at this point (See Appendix A).

Calling Sequence:

TBOFF
CALL TABOFF

* Arming the Tablet suppresses data sent to the terminal screen if the Echo Suppression is strapped IN (See Appendix A).

Accepting a Point
Subroutine: GETPNT

3.3 This routine is also called by subroutines MULPNT and ONEPNT. It returns the coordinates of either an input point from the Tablet, or the beam position on the terminal screen, depending on the header character which is returned to the user.

Calling Sequence:

~~GETPT~~
CALL GETPNT(IH, IX, IY)

Parameters Returned:

IH The header character of the point. If IH is a Tablet header, then the coordinates will be those of the point input. If IH is a terminal status header, then the coordinates will be the terminal beam position. Terminal status is sent to indicate the writing pen has left presence; if the Tablet is not armed, the terminal status is not sent when the Tablet is next armed.

NOTE: If IH is a user keyboard input, then the coordinates returned will be meaningless.

IX The X-coordinate of the point.

IY The Y-coordinate of the point.

Headers Returned By Subroutine GETPNT Are:

<u>Value</u>	<u>Input Characters</u>	<u>Meaning</u>
26	SUB or J*	No change in the header character
29	GS or M*	Pen Depressed
31	US or O*	Pen Released
32-63	Terminal Status	Pen Removed from Presence
Greater than 63, but NOT 74, 77, or 79		User Keyboard Input

* The Header Character Strap: This strap should be set to CONTROL if SUB, GS, and US can be input by the computer system. Setting the strap to LETTER will change these header characters to J, M, and O. If the strap is set to LETTER, letter headers will replace the vectors on the terminal screen when the Tablet is in local display. See Appendix A.

SECTION 4

EXAMPLES

The following examples give the user a set of typical applications for the Graphics Tablet Utility Routines. Included with each example is a description of its purpose.

EXAMPLE 1

An Application of ONEPNT

This example uses ONEPNT in pen mode to accept a point and then draws a box around that point on the screen using the Terminal Control System. This method may be used to position more complex designs and symbols anywhere on the terminal screen.

```
10 CALL INITT (30)
   CALL TABINT (0,0,0)
   CALL ONEPNT (IX,IY)
   CALL MOVABS (IX,IY)
   CALL MOUREL (-50,-50)
   CALL DRUREL (100,0)
   CALL DRUREL (0,100)
   CALL DRUREL (-100,0)
   CALL DRUREL (0,-100)
   CALL TINPUT (J)
   IF (J.EQ.85) GO TO 10
   CALL FINITT (0,0)
END
```

Example 2

An Application of Mulpnt

This program uses Mulpnt in pen mode to accept twenty points and graph them using the Terminal Control System. Since Mulpnt returns a header character for each point, the data may be graphed in segments (using either a move or a draw), depending on when the pen entered and left the presence of the Tablet. The CR strap on the Tablet may be either IN or OUT.*

```

                                DIMENSION IH(20),IX(20),IY(20)
                                CALL INITT (30)
                                CALL TABINT (0,0,0)
                                CALL Mulpnt (20,NUM,IH,IX,IY)
                                DO 10 I=1,NUM
10      IF (IH(I).EQ.29) CALL MOUABS (IX(I),IY(I))
        IF (IH(I).EQ.26) CALL DRWABS (IX(I),IY(I))
        CALL FINITT (0,0)
        END
```

* See the note on the CR strap in Appendix A.

Example 3

Multiple/Presence Mode on the Tablet

This program shows how to use Mulpnt to implement multiple/presence mode on a half-duplex system* (i.e., multiple points are sent either when the pen is depressed or when it is in presence). The limitation is that the user must be careful not to send enough points to overrun the Terminal Control System input buffer (the size of the input buffer depends on implementation, but it is usually the same as the system input buffer size). The CR strap on the Tablet should be OUT.

```
10      DIMENSION IH(50),IX(50),IY(50)
        CALL INITT (30)
        CALL TABINT (0,0,1)
        CALL Mulpnt (50,NUM,IH,IX,IY)
        DO 10 I=1,NUM
          IF (IH(I).EQ.29) CALL MOUABS (IX(I),IY(I))
          IF (IH(I).EQ.26) CALL DRWABS (IX(I),IY(I))
        CALL FINITT (0,0)
        END
```

* See the note on the CR strap in Appendix A.

Example 4

Multiple/Presence Mode on a Full-Duplex System

This program shows how to implement multiple/presence mode on a full-duplex system* while placing no restrictions on the user. The filtering algorithm in the program graphs only those points whose headers are either a GS or a SUB (when no other header but SUB has been received since the last GS). The CR strap on the Tablet must be IN.

See Example 3 for an example of multiple/presence mode on a half-duplex system.

```

C * EXAMPLE USING LEVEL TWO ROUTINES AND FILE I/O
C * TO ACCEPT AND GRAPH AN INDEFINITE NUMBER OF POINTS
C * WITH TABLET IN MULTIPLE/PRESENCE MODE
      CALL INITT (30)
      CALL TABINT (0.1,1)
      CALL OFILE (1,'TBDAT')
      WRITE (5,10)
10    FORMAT (1X,'PROCEED - ENTER S FROM KEYBOARD TO END')
C * ACCEPT POINTS AND WRITE THEM TO FILE
20    CALL TABARM (1)
30    CALL GETPNT (IH,IX,IY)
      IF (IH.EQ.83) GO TO 50
      WRITE (1,40) IH,IX,IY
40    FORMAT (3I5)
      IF (IH.GE.32.AND.IH.LE.63) GO TO 20
      GO TO 30
50    CALL TABOFF
C * CLOSE AND REOPEN FILE TO READ DATA
      ENDFILE 1
      CALL IFILE (1,'TBDAT')
C * FILTER OUT EXTRANEIOUS POINTS AND GRAPH VALID POINTS
      I=1
60    READ (1,40,END=90) IH,IX,IY
      IF (IH.EQ.29) GO TO 70
      IF (IH.EQ.28) GO TO 80
      I=1
      GO TO 60
70    CALL MOVABS (IX,IY)
      I=0
      GO TO 60
80    IF (I.EQ.1) GO TO 60
      CALL DRUABS (IX,IY)
      GO TO 60
90    ENDFILE 1
      CALL FINITT (0.0)
      END

```

* See the note on the CR strap in Appendix A.

Example 5

Tracking in Single/Presence Mode

When the COMSUP strap is set to IN (see Appendix), it is possible in single/presence mode to use the screen alphanumeric cursor to "track" the pen location. The example program shows how to do this as well as how to draw at the same time from point to point on the screen. The move and draw commands may be deleted if the drawing is not desired.

NOTE

Local display must be selected when calling subroutine TABINT.

```

DIMENSION IH(100),IX(100),IY(100)
CALL INITT (30)
CALL TABINT (0,1,1)
DO 100 I=1,100
50  CALL TABARM (0)
    CALL GETPNT (IH(I),IX(I),IY(I))
    IF (IH(I) .GT. 63) GO TO 150
    IF (IH(I) .GT. 29) GO TO 50
    CALL TABOFF
    IF (I .EQ. 1) GO TO 100
    CALL MOVABS (0,0)
    CALL MOVABS (IX(I-1),IY(I-1))
    CALL DRUABS (IX(I),IY(I))
    CALL TOUTPT (31)
100  CONTINUE
150  CALL TABOFF
    CALL FINITT (0,0)
END

```


APPENDIX A

**STRAPPING OPTIONS
FOR THE GRAPHICS TABLET**

STRAPPING OPTIONS FOR THE GRAPHICS TABLET

Eight straps on the circuit boards of a 4010-Series Computer Display Terminal equipped with a 4953 or 4954 Graphics Tablet should be in specific settings to allow the Graphics Tablet Utility Routines to operate properly. The GIN-mode strap on the TC2 board should be set according to Terminal Control System requirements.

The seven straps on the Graphics Tablet interface board appear as follows:

<u>NAME</u>	<u>OPTIONS</u>
DELAY	IN/OUT
ESUP	IN/OUT
CR	IN/OUT
HEADER	CONTROL/LETTER
SIZE	LARGE/SMALL
COMSUP	IN/OUT
STATUS	IN/OUT

DELAY

Set this strap to IN so that the maximum rate of transmission from the Tablet may be lowered via the "pot" next to the strap. The adjustment ranges from about 1200 baud down to under 300 baud, while the rate of transmission with the strap OUT is around 9600 baud; the screen on a 4010, 4012, or 4013 Terminal may be damaged by the very short, very bright vectors generated with the DELAY strap OUT.

ESUP

Set this strap to IN in order to keep unwanted characters from appearing on the screen during transmission.

CR

This strap determines whether a CR is sent following the 5 (or 6) characters sent for each point. The strap should be set as follows:

- (a) If the GIN-mode strap on the TC2 circuit board is set to NONE, set CR to OUT.
- (b) When using single point mode (as in ONEPNT), set the CR to IN, except in the situation covered in (a).
- (c) When using multiple point mode (as in Mulpnt), set CR to:
 - 1) IN - if the computer system is full-duplex and can accept input continuously, except in the situation covered in (a).
 - 2) OUT - if the computer system is half-duplex and sends a prompt to indicate it is ready to accept input.

HEADER

Set this to LETTER when transmitting to a CPU, unless the Terminal Control System input routine TINSTR can accept the control characters GS, SUB, and US. With the Terminal in LOCAL, this strap may be set to CONTROL for graphics display. See Section 3.3: GETPNT.

SIZE

Set this to SMALL for a 4953 Tablet, LARGE for a 4954 Tablet.

COMSUP

When the pen is tracking in presence mode, setting this strap to IN allows the tracking to occur without transmission of points (until the pen is depressed).

STATUS

Setting this strap to OUT causes transmission of the terminal status character to be suppressed when the pen leaves presence. If this option is selected, the source code of subroutine TABARM should be changed. Line 880 should become:

```
IF(MULT.NE.Ø)NPNTS=34
```

ASCII CODE CHART

BITS B7 B6 B5 B4 B3 B2 B1				0 0 0		0 0 1		0 1 0		0 1 1		1 0 0		1 0 1		1 1 0		1 1 1	
				CONTROL		HIGH X & Y GRAPHIC INPUT		LOW X		LOW Y									
0	0	0	0	NUL	DLE	SP	0	@	P	\	p	0 (0)	10 (16)	20 (32)	30 (48)	40 (64)	50 (80)	60 (96)	70 (112)
0	0	0	1	SOH	DC1	!	1	A	Q	a	q	1 (1)	11 (17)	21 (33)	31 (49)	41 (65)	51 (81)	61 (97)	71 (113)
0	0	1	0	STX	DC2	"	2	B	R	b	r	2 (2)	12 (18)	22 (34)	32 (50)	42 (66)	52 (82)	62 (98)	72 (114)
0	0	1	1	ETX	DC3	#	3	C	S	c	s	3 (3)	13 (19)	23 (35)	33 (51)	43 (67)	53 (83)	63 (99)	73 (115)
0	1	0	0	EOT	DC4	\$	4	D	T	d	t	4 (4)	14 (20)	24 (36)	34 (52)	44 (68)	54 (84)	64 (100)	74 (116)
0	1	0	1	ENQ	NAK	%	5	E	U	e	u	5 (5)	15 (21)	25 (37)	35 (53)	45 (69)	55 (85)	65 (101)	75 (117)
0	1	1	0	ACK	SYN	&	6	F	V	f	v	6 (6)	16 (22)	26 (38)	36 (54)	46 (70)	56 (86)	66 (102)	76 (118)
0	1	1	1	BEL	ETB	/	7	G	W	g	w	7 (7)	17 (23)	27 (39)	37 (55)	47 (71)	57 (87)	67 (103)	77 (119)
1	0	0	0	BS	CAN	(	8	H	X	h	x	8 (8)	18 (24)	28 (40)	38 (56)	48 (72)	58 (88)	68 (104)	78 (120)
1	0	0	1	HT	EM	)	9	I	Y	i	y	9 (9)	19 (25)	29 (41)	39 (57)	49 (73)	59 (89)	69 (105)	79 (121)
1	0	1	0	LF	SUB	*	:	J	Z	j	z	A (10)	1A (26)	2A (42)	3A (58)	4A (74)	5A (90)	6A (106)	7A (122)
1	0	1	1	VT	ESC	+	;	K	[	k	{	B (11)	1B (27)	2B (43)	3B (59)	4B (75)	5B (91)	6B (107)	7B (123)
1	1	0	0	FF	FS	,	<	L	\	l	!	C (12)	1C (28)	2C (44)	3C (60)	4C (76)	5C (92)	6C (108)	7C (124)
1	1	0	1	CR	GS	-	=	M	]	m	}	D (13)	1D (29)	2D (45)	3D (61)	4D (77)	5D (93)	6D (109)	7D (125)
1	1	1	0	SO	RS	.	>	N	^	n	~	E (14)	1E (30)	2E (46)	3E (62)	4E (78)	5E (94)	6E (110)	7E (126)
1	1	1	1	SI	US	/	?	O	_	o	RUBOUT (DEL)	F (15)	1F (31)	2F (47)	3F (63)	4F (79)	5F (95)	6F (111)	7F (127)

