Software Version 6.3

Wild Plotter TA10S, TA10, TA10BL, TA10BXL

Instruction manual

Leica

Contents

1. Control commands

Buffer capacities: Input buffer 512byte (380byte + 132byte)
Segment buffer 256byte (32 vectors)
Output buffer 14byte

1.1 Generally

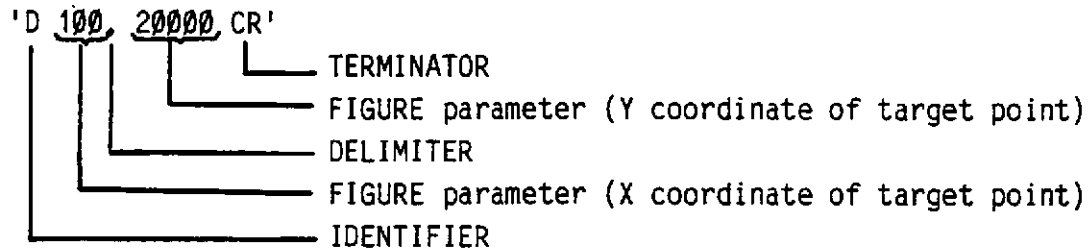
1.1.1 Command structure

The set of commands for the TA 2 consists of about fifty commands. These may be divided into the following groups:

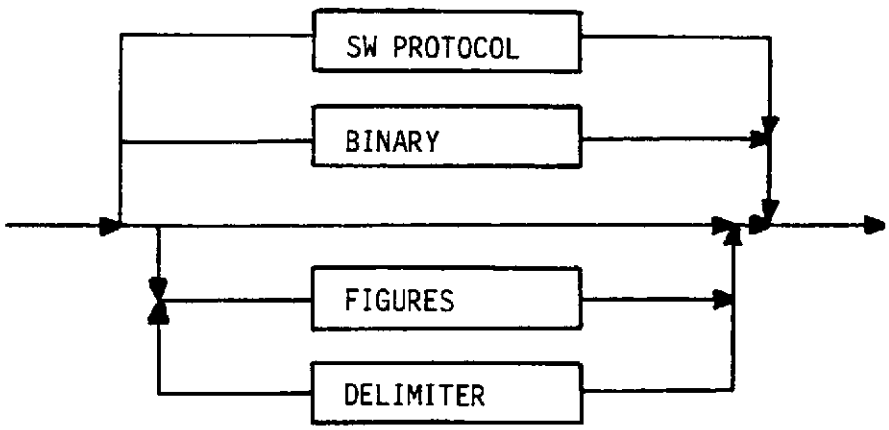
- initialization and query commands
- vector commands
- commands for generating annotations, symbols and circles

Structure of a command

Example of the command for plotting a straight line:

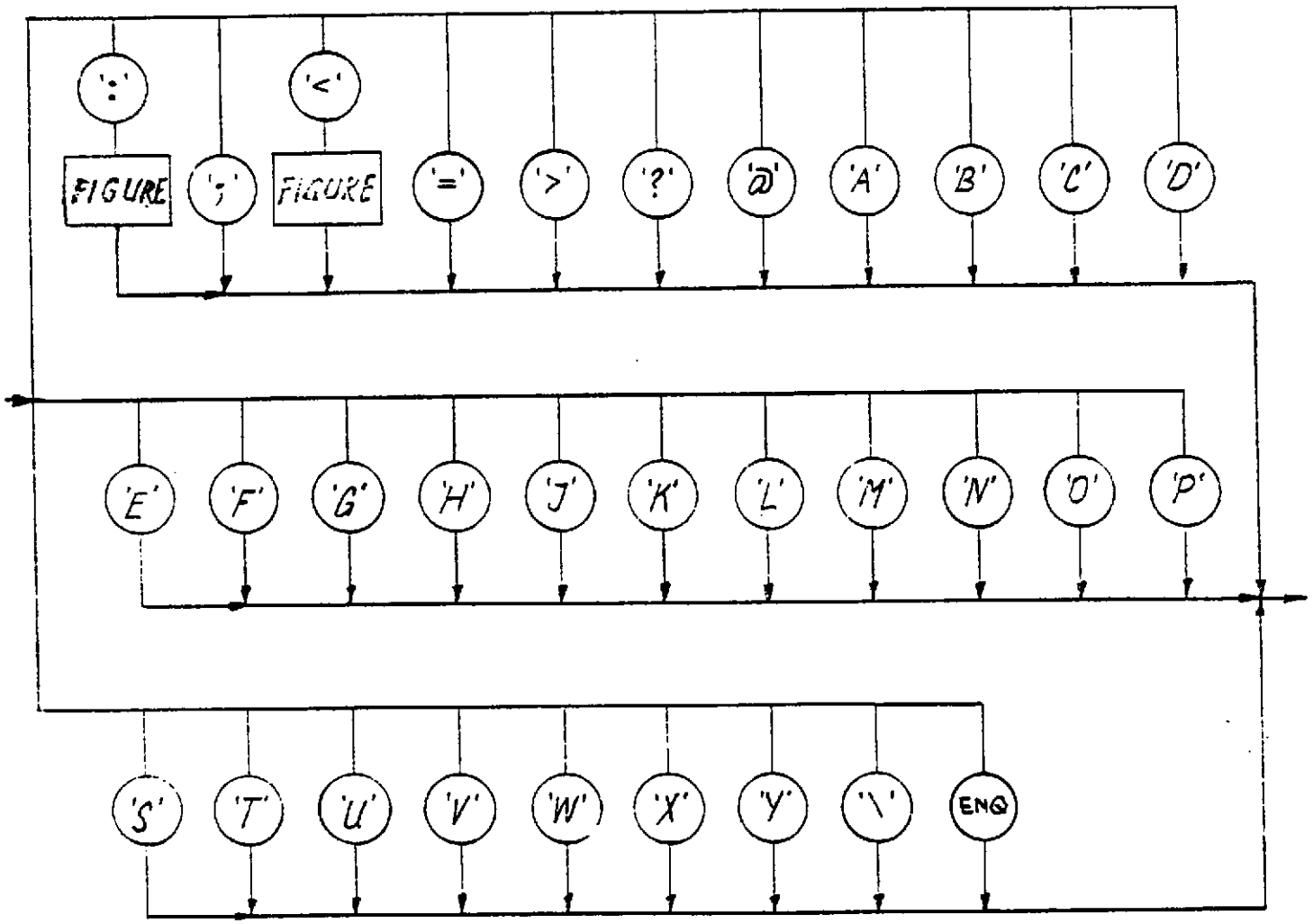


Structure of a PARAMETER block



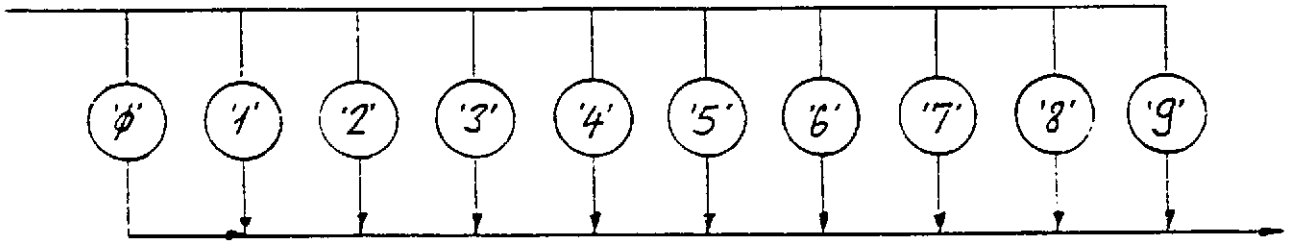
Every IDENTIFIER has a specific type of parameter.

Structure of an IDENTIFIER

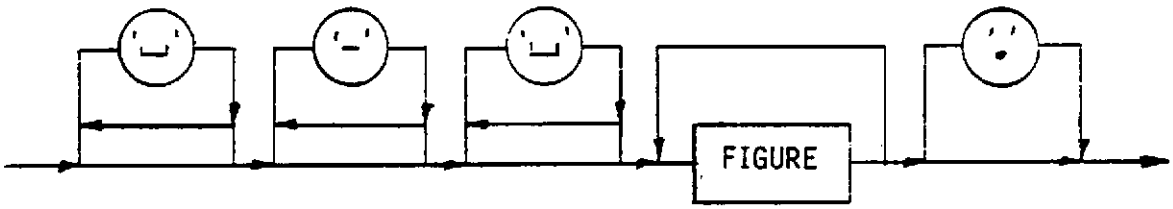


It is also permissible for lower-case letters to be used for the identifiers A to Y

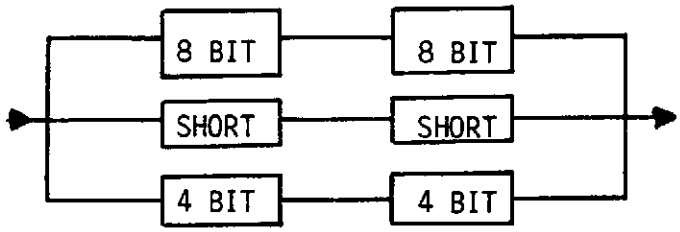
Structure of a FIGURE



Structure of a FIGURE parameter



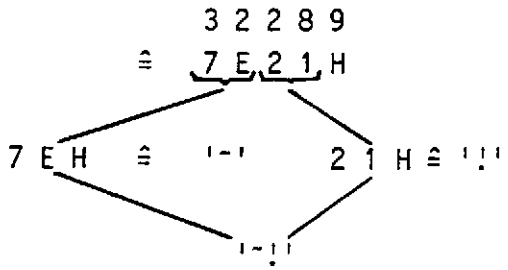
Structure of a BINARY parameter block



Structure of 8-bit binary parameters

- The structure consists of two binary 8-bit characters

  Example:



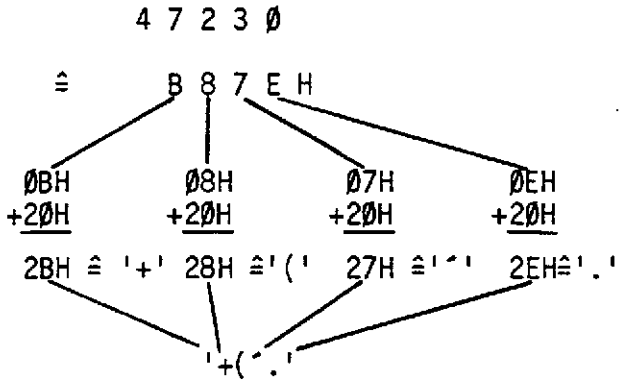
  There are no ASCII-equivalent characters for code >7EH.

- Possible without software-interface protocol only with 8-bit data transfer

Structure of 4-bit binary parameters

- Consists of 4 binary characters
- The four lower nibbles (bits Ø to 3) are assembled to form the required 16-bit coordinates
- The characters must have an offset of ≥2ØH. Thus, they come to lie outside the control-character range [Ø...1FH] and are thus unable to affect the software protocol.

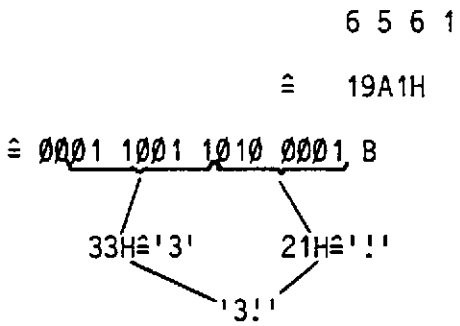
Example: offset = 20 H



Structure of SHORT parameters

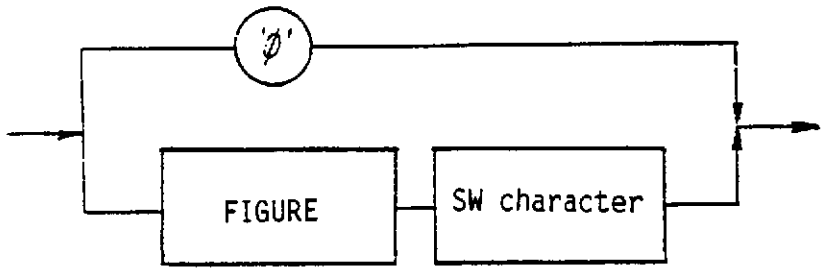
- Consists of two binary characters, of which only bits (Ø...6) are used

Example:



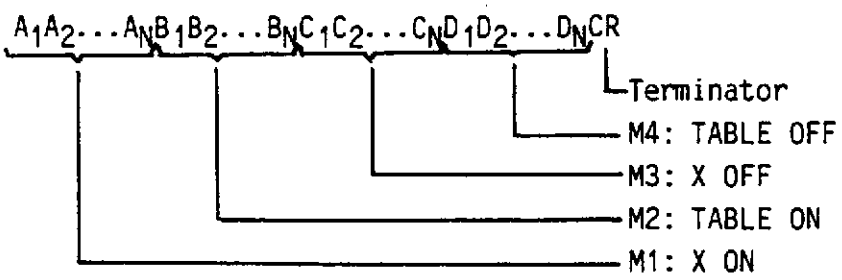
- Only figures from -8192 to +8191 can be represented by these parameters
- The software protocol cannot be used here

Structure of the SW PROTOCOL parameter block



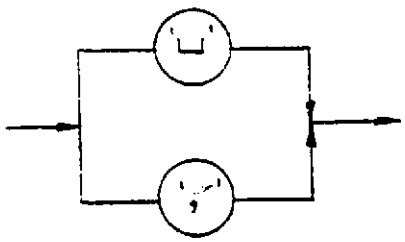
- If the figure = 'Ø', a change-over is made to the hardware protocol
- The FIGURE ('Ø'<FIGURE≤'6') determines the number of control characters N per control message

Structure of software characters

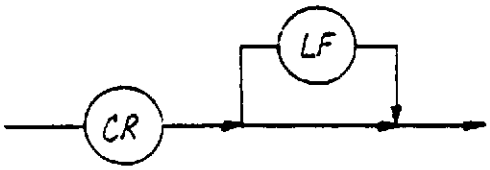


- The characters $A_1...A_N$, $D_1...D_N$ may contain any ASCII control character (characters <2ØH), except for LF (ØAH) and CR (ØDH)
- In messages to the TA 2, only the first character is checked, but all FIGURE characters are transmitted

Structure of a DELIMITER



Structure of a TERMINATOR



Legend:

''	stands for ASCII-equivalent character
␣	stands for blank, space
LF	stands for line feed (ØAH)
CR	stands for carriage return (ØDH)

Table coordinates

Each X and/or Y increment is 2/1ØØmm (Ø.Ø2mm)

The effective plotting area is 12ØØmm x 12ØØmm. Thus, the range for the two table axes is

Ø ≤X, Y ≤6ØØØØ increments

For the quadruple plotting head the effective plotting area is

Ø ≤X ≤57637 increments
Ø ≤Y ≤6ØØØØ increments

ASCII character set

dec	hex	oct	character	dec	hex	oct	character	dec	hex	oct	character
0	0	0	NUL	43	2B	53	+	86	56	126	V
1	1	1	SOH	44	2C	54	,	87	57	127	W
2	2	2	STX	45	2D	55	-	88	58	130	X
3	3	3	ETX	46	2E	56	.	89	59	131	Y
4	4	4	EOT	47	2F	57	/	90	5A	132	Z
5	5	5	ENQ	48	30	60	Ø	91	5B	133	[
6	6	6	ACK	49	31	61	1	92	5C	134	\
7	7	7	BEL	50	32	62	2	93	5D	135	]
8	8	10	BS	51	33	63	3	94	5E	136	↑
9	9	11	HT	52	34	64	4	95	5F	137	←
10	A	12	LF	53	35	65	5	96	60	140	`
11	B	13	VT	54	36	66	6	97	61	141	a
12	C	14	FF	55	37	67	7	98	62	142	b
13	D	15	CR	56	38	70	8	99	63	143	c
14	E	16	SO	57	39	71	9	100	64	144	d
15	F	17	SI	58	3A	72	:	101	65	145	e
16	10	20	DLE	59	3B	73	;	102	66	146	f
17	11	21	DC1	60	3C	74	<	103	67	147	g
18	12	22	DC2	61	3D	75	=	104	68	150	h
19	13	23	DC3	62	3E	76	>	105	69	151	i
20	14	24	DC4	63	3F	77	?	106	6A	152	j
21	15	25	NAK	64	40	100	@	107	6B	153	k
22	16	26	SYN	65	41	101	A	108	6C	154	l
23	17	27	ETB	66	42	102	B	109	6D	155	m
24	18	30	CAN	67	43	103	C	110	6E	156	n
25	19	31	EM	68	44	104	D	111	6F	157	o
26	1A	32	SUB	69	45	105	E	112	70	160	p
27	1B	33	ESC	70	46	106	F	113	71	161	q
28	1C	34	FS	71	47	107	G	114	72	162	r
29	1D	35	GS	72	48	110	H	115	73	163	s
30	1E	36	RS	73	49	111	I	116	74	164	t
31	1F	37	US	74	4A	112	J	117	75	165	u
32	20	40	_	75	4B	113	K	118	76	166	v
33	21	41	!	76	4C	114	L	119	77	167	w
34	22	42	"	77	4D	115	M	120	78	170	x
35	23	43	#	78	4E	116	N	121	79	171	y
36	24	44	$	79	4F	117	O	122	7A	172	z
37	25	45	%	80	50	120	P	123	7B	173	{
38	26	46	&	81	51	121	Q	124	7C	174	|
39	27	47	'	82	52	122	R	125	7D	175	}
40	28	50	(	83	53	123	S	126	7E	176	~
41	29	51	)	84	54	124	T	127	7F	177	DEL
42	2A	52	*	85	55	125	U				

1.1.2 Summary of TA10 control commands

Page	Command	Description
14	:	Initialization of plotting-table parameters
30	;	Annotation as L, but with origin offset
21	<	Request for table coordinates and parameters
29	=	Absolute 8-bit binary vector with plotting point down
29	>	Absolute 8-bit binary vector with plotting point up
28	?	Absolute 4-bit binary vector with plotting point down
28	@	Absolute 4-bit binary vector with plotting point up
28	A	Relative vector with plotting point up
28	B	Relative vector with plotting point down
37	C	Circle with continuous line
26	D	Absolute vector with plotting point down
36	E	Circle or circular arc with continuous line
36	F	Circle or circular arc with long-dashed line
36	G	Circle or circular arc with short-dashed line
36	H	Circle or circular arc with dotted line
36	J	Circle or circular arc with dot-dashed line
20	K	Initialization of plotting parameters
32	L	Annotation (letters, figures, symbols), long format
33	M	Annotation (letters, figures, symbols), short format
25	N	Manual-mode software
37	O	Circular symbol, short format
20	P	Plotting point selection Pen Around
29	S	Short vector with plotting point down, rel. 7bit binary
29	T	Short vector with plotting point up, rel. 7bit binary
26	U	Absolute vector with plotting point up
27	V	Absolute vector with long-dashed line
27	W	Absolute vector with short-dashed line
27	X	Absolute vector with dotted line
27	Y	Absolute vector with dot-dashed line
11	\	Initialization of SW protocol
13	ENQ	Initialization of ENQ/ACK protocol
38	]	Comment / Roll feed

1.2 Initialization and request commands

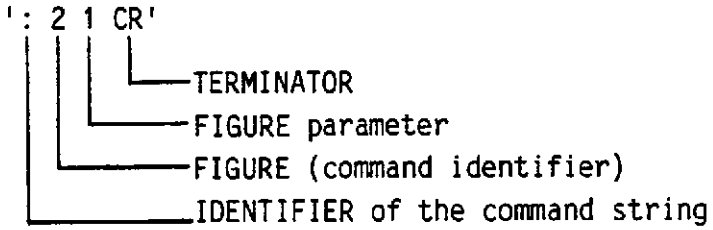
These commands enable the operating modes of the table to be determined or requested.

In the case of

- initialization of plotting-table parameters (':')
- request for coordinates and parameters ('<')

we are dealing with command strings. In the case of a command string, the identifier consists of two characters.

Example:



All initializations are lost when the table is switched off.

1.2.1 Default values

Description of command	Change by	See page	Default values
Interface protocol	'\',ENQ	11	Hardware protocol (CTS, RTS)
Reference coordinate	':1'	15	Table reference Ø,Ø
Acceleration	':2'	15	Maximum acceleration (5m/s^2)
Circle resolution	':3'	15a	Normal resolution
Character set selected	':4'	16	Standard ASCII set
Time required to raise/lower plotting head	':5'	16	Normal plotting tool: lowering time = 25ms, raising time = 18.75ms Tangentially controlled plotting tool: lowering time = 25ms, raising time = 25ms
Plotting output	':6'	17	Full plotting output
Maximum speeds	':7'	17	'Pen down' by multiswitch 'Pen up' speed = 296mm/s
Rotating ball-point pen	':8'	18	Switched off
Pencil-lead automatic feed	':9'	19	Switched off
Vector to start of circle	':A'	19	Pen up vector
Switch of table mode	':B'	19a	Manual mode
Auto report	':C'	19b	Off (no report)
Change of coordinate system	':D'	19c	Off (X horizontal)
Auto pen-lift at angular discontinuities	':E'	19d	Off
Annotation angle for text	'K'	20	In positive X direction ≙Ø°
Scale for lettering height	'K'	20	1Ømm
Radius of predefined circle	'K'	20	1mm
Length of short dash	'K'	20	5mm
Plotting point selected	'P'	20	Plotting point 1
Sense of rotation for circles	'E','F' 'G','H' 'J','C'	36	Clockwise
Table mode after switching on	-		Manual mode
Plotting-point position after switching on	-		Top right (after search for reference mark)

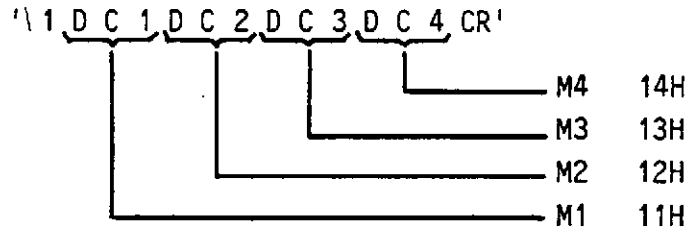
1.2.2 Initialization of interface protocol

1.2.2.1 Initialization of SW protocol

Function:

- to activate and inactivate the software protocol
- to determine the number and type of control characters
- if the command is accepted, the TA 2 acknowledges by output of the SW-version data
- the following vector commands must not be used with the SW protocol:
  - 'S' short vector, 7-bit binary, pen down
  - 'T' short vector, 7-bit binary, pen up
  - '=' absolute 8-bit binary vector, pen down
  - '>' absolute 8-bit binary vector, pen up
- the absolute 4-bit binary vectors '?', @ must have an offset of =20H to ensure that they will not come to lie within the range of the control characters
- if the message has a format error, the system switches over to hardware protocol
- as long as no valid initialization has taken place, the table works with the hardware protocol (CTS, RTS)
- CTS = H when working with SW protocol.

Example:

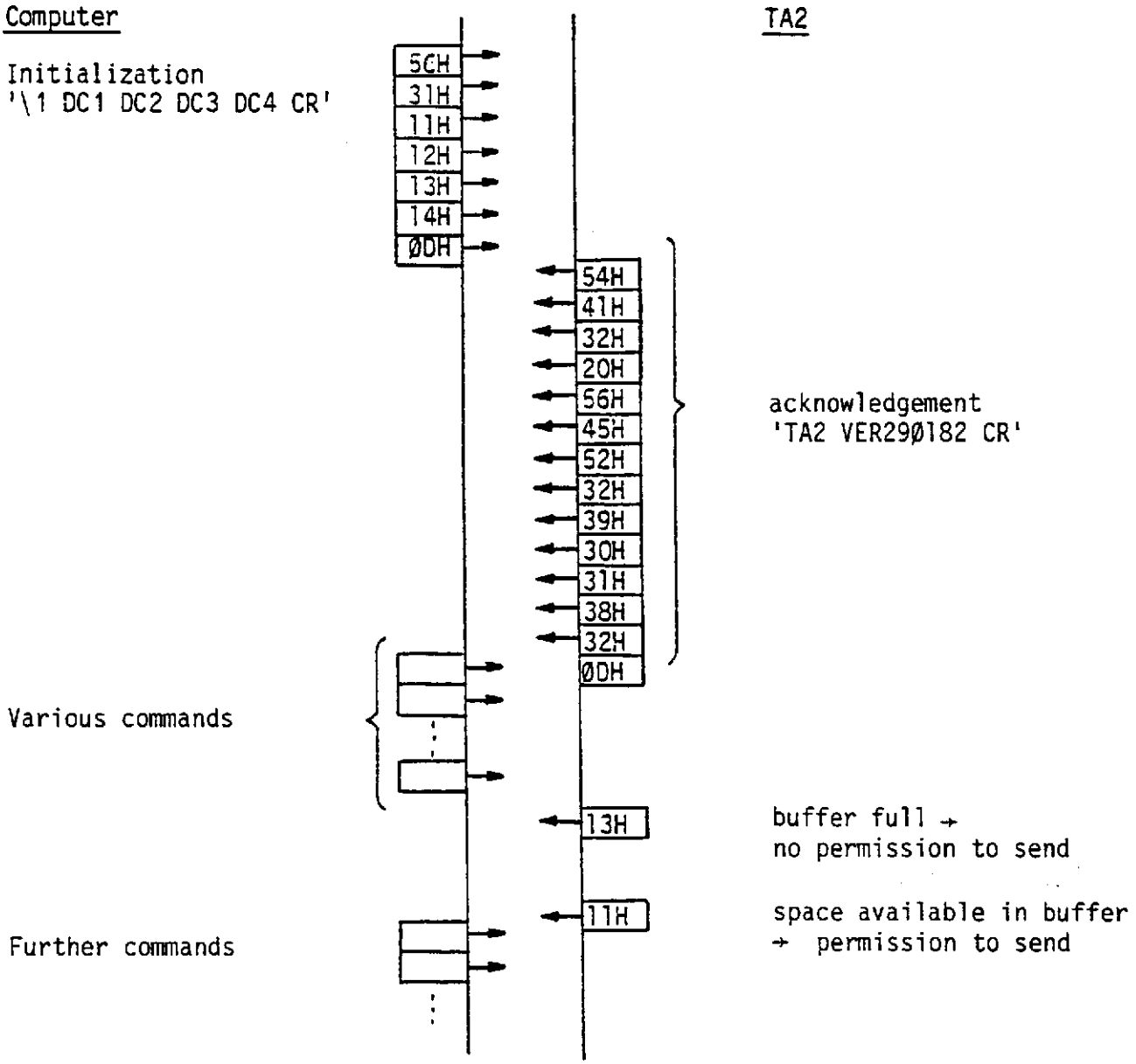


As this initialization is correct, the TA 2 acknowledges the fact with the message

'TA2 VERXXYYZZ CR'

where XX = day
YY = month
ZZ = year

Note:
The SW protocol can only be initialized with the HW protocol, otherwise initialization is invalid (→ may first have to be switched off).



Message direction

Message	Sender	Receiver	Information
M1	TA 2	Computer	enables computer to send
M2	Computer	TA 2	enables TA 2 to send
M3	TA 2	Computer	disables computer from sending
M4	Computer	TA 2	disables TA 2 from sending

Switching out of the SW protocol

The following command switches the TA 2 from software protocol to hardware protocol:

'\ØCR'

This command is also confirmed by a message of the version.
On being switched on, the table is always on hardware protocol.

1.2.2.2 Initialization of ENQ/ACK protocol

Function:

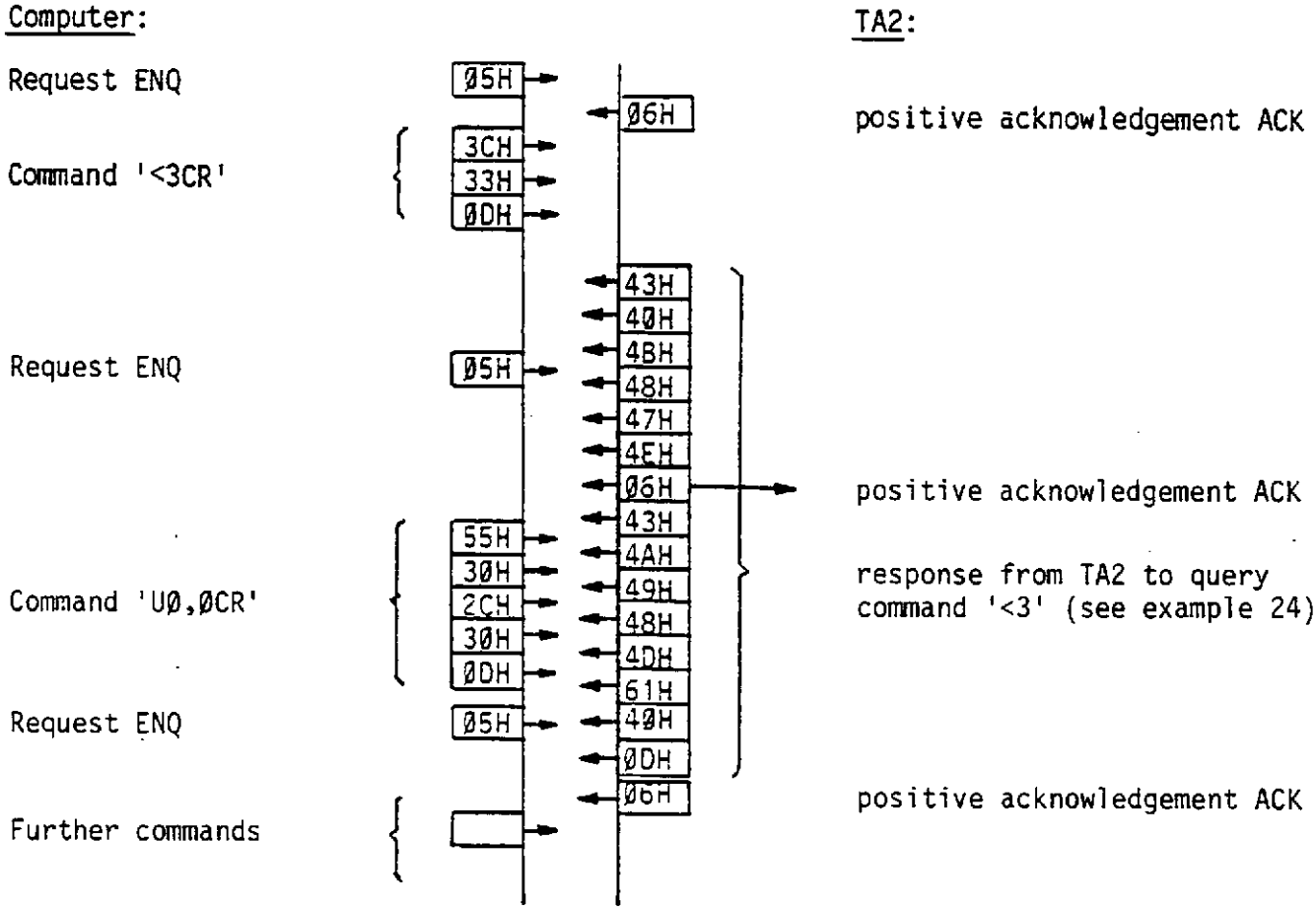
- to activate the ENQ/ACK protocol. The TA2 acknowledges with ACK(Ø6H) as soon as there is space in the input buffer for 128 bytes.
- the following vector commands must not be used in ENQ/ACK protocol:
  'S' short vector 7bit binary, pen down
  'T' short vector 7bit binary, pen up
  '=' absolute 8bit binary vector, pen down
  '>' absolute 8bit binary vector, pen up
- the absolute 4bit binary vectors '?', '@' must be provided with an offset =20H to ensure that they will not come to lie within the range of the control characters
- as long as no valid initialization has taken place, the table works with the hardware protocol (CTS, RTS)
- for ENQ/ACK protocol, CTS must equal High.

Command format:

ENQ (Ø5H)

Notes:
- the TA2 acknowledges only with the positive response (ACK)
- this protocol can be switched off similarly to the SW protocol, by using the command ' ØCR' (see page 12).

Example:



1.2.3 Initialization of plotting-table parameters

This command string contains the following commands:

Identifier	Command description
':Ø'	Change window
':1'	Change reference coordinate
':2'	Change acceleration
':3'	Change circle resolution
':4'	Select character set
':5'	Change waiting time for raising and lowering plotting tool
':6'	Use average plotting output
':7'	Change maximum plotting speed
':8'	Initialization of tangentially controlled plotting tool
':9'	Initialization of pencil-lead automatic feed
':A'	Initialization of vector to start of circle
':B'	Switch to manual or computer mode
':C'	Initialization of automatic report
':D'	Change coordinate system X/Y Y/X (TA10 only)
':E'	Initialization of automatic pen-lift at angular discontinuities

Change window [':Ø']

Function:

- to set the window relative to the reference

Command format:

```
:Ø Xmin, Xmax, Ymin, Ymax CR
          |     |     |    |
          |     |     |    └──── FIGURE parameter for max. Y coordinate
          |     |     └───────── FIGURE parameter for min. Y coordinate
          |     └─────────────── FIGURE parameter for max. X coordinate
          └───────────────────── FIGURE parameter for min. X coordinate
```

Conditions:

- the coordinates must lie within the maximum plotting surface
- the window can be changed by manual SET WINDOW

Example:

```
'11ØØØ, ØCR'
':Ø-1ØØØ, 59ØØØ, Ø, 6ØØØØCR'
```

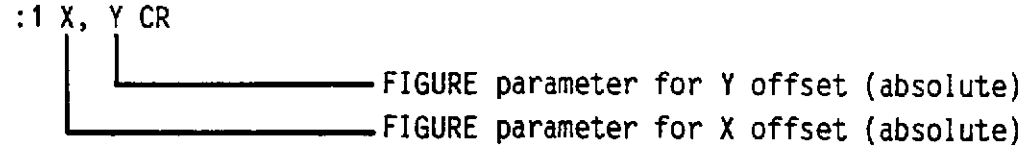
Sets the window for the maximum plotting surface relative to the reference (1ØØØØ.Ø).

Change reference coordinate [':1']

Function:

- to change the reference. Same function as manual SET REFERENCE. However, buffers are not deleted.

Command format:



Conditions:

- X and Y have to be valid table coordinates
- may be altered by manual SET REFERENCE
- the same restrictions apply for windows as for manual SET REFERENCE

Example:

':130000,30000CR'

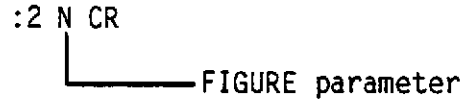
Following the command ' U0,0CR', the plotting point will be in the table centre.

Change acceleration [':2']

Function:

- to change the acceleration from 5m/s^2 to 2.5m/s^2 and vice versa.

Command format:



where N = 1 maximum acceleration (5m/s^2)
N = 2 half acceleration (2.5m/s^2)

Conditions:

- on switching on the table, the setting is always for full acceleration
- if the switch on the plotting-head carriage is set to QUALITY or if the tangentially controlled scribing tool is inserted, the table is always automatically set to half acceleration. However, the software status is maintained.

Example:

':22CR' switches to half acceleration

Change circle resolution

Function:

- the resolution of circles/arcs can be doubled

Command format:

```
:3 N CR
   └──── FIGURE parameter
```

where N = 1 selects normal resolution (default)
N = 2 selects double resolution

Example:

':32 CR' switches to double circle resolution, e.g. with radius = 10mm, a full circle contains 90 vectors (each approx. 0.7mm long).

Select character set [':4']

Function:

- to change from one character set to another

Format:

```
:4NCR
  |
  └──────FIGURE parameter
```

where N = 1 selects the ASCII character set
N = 2 selects the European character set
N = 3 selects the photogrammetry character set
..... possibly other character sets

Note:

- this switch-over does not affect the photogrammetry character set ('L' and 'M' command)
- character sets see section 1.4.1

Example:

':42CR' switches to the European character set

Change delay time for raising and lowering plotting tool [':5']

Function:

- to change the delay time for raising or lowering the plotting tool

Command format:

```
:5 N,M CR
   | |
   └─└──────FIGURE parameter
```

where N time required to lower plotting tool
M time required to raise plotting tool
lowering time = N x 1.25ms
raising time = M x 1.25ms

Conditions:

- N and M must keep to the following values:
  $0 \leq N, \quad M \leq 65000$
- When the tangentially controlled tool is used, these times are changed

Example:

':58, 16CR'

Changes the lowering time to 8 x 1.25ms = 10ms
and the raising time to 16 x 1.25ms = 20ms

Reduce average plotting output [':6']

Function:

- changing the average plotting speed in two steps (full and reduced)

Command format:

```
:6 N CR
   |
   └──── FIGURE parameter
```

where N = 1 selects full average plotting speed
N = 2 selects reduced average plotting speed

Conditions:

- it may be an advantage to reduce the average plotting output if the work load for the table is too small. This is shown by the fact that the slope change is used only to a limited extent or not at all. In that event, the table is operating on a stop-start basis.

Example:

':62CR' reduces the plotting output

Change maximum plotting speed [':7']

Function:

- to change the 'pen down' and/or 'pen up' speed

Command format:

:7VD,VUCR or :7VDCR; VD,VU = FIGURE parameters

where VD is the speed with plotting tool down (VD = Ø = multiswitch)
VU is the speed with plotting tool up
The speed = VD x 8mm/s and VU x 8 mm/s

Conditions:

- if the maximum speed is determined by this command, the multiswitch for the manual setting of the 'pen down' speed is inactive
- for VD and VU, the following ranges apply:

1 ≤VD, VU ≤37, i.e.

8mm/s ≤ maximum speed ≤296mm/s

Examples:

':724,16CR'

gives a plotting speed with plotting tool down of 24 x 8mm/s = 192mm/s
and with plotting tool up of 16 x 8mm/s = 128mm/s

':71ØCR'

gives a plotting speed with plotting tool down of 80mm/s; the speed with the plotting tool up remains unchanged

Return speed control to multiswitch

with ':7ØCR' ':7Ø,VUCR'

Multiswitch Position	the speed is determined by the multiswitch (as in the default status)				the pen down speed is determined by the multiswitch, pen up speed is VU*8mm/s		
	Pen down TA2	TA10	Pen up TA2	TA10	Pen down TA2	TA10	Pen up
1	8mm/s	5	200mm/s	145	8	5	VU * 8mm/s
2	16mm/s	15	200mm/s	145	16	15	|
3	32mm/s	25	200mm/s	145	32	25	|
4	64mm/s	45	200mm/s	145	64	45	|
5	128mm/s	80	200mm/s	195	128	80	|
6	200mm/s	145	200mm/s	145	200	145	|
7	256mm/s	200	256mm/s	200	256	200	|
8	296mm/s	250	296mm/s	250	296	250	VU * 8mm/s

Initialization of tangentially controlled plotting tool [':8']

Function:

- to initialize plotting mode for the tangentially controlled plotting tool

Command format:

```
:8 N CR
   └──── FIGURE parameter
```

where N = 1 the tangentially controlled scribing point is inserted (default)
N = 2 the rotating ball-point pen is inserted
N = 3 the single-sided cutting point is inserted

Conditions:

- the tool rotates only if the tangential control has been correctly initialized (inserted)
- the acceleration is automatically reduced ($2.5 m/s^2$)
- the default values for tangential control are adopted for raise/lower times
- the plotting tool must be inserted in the Pen 1 position

Example:

':82CR'

When the tangentially controlled plotting tool is inserted, this switches over to rotation

Note:

- the amount of rotary movement is dependent on the distance plotted

Initialization of pencil-lead automatic feed [':9']

Function:

- to switch pencil-lead automatic feed controlled from the plotting table on and off

Command format:

```
:9 N CR
   |
   └──────── FIGURE parameter
```

where N = 1 Switches automatic feed off
N = 2 Switches automatic feed on

Conditions:

- This tool must be inserted at pen 1

- acceleration is automatically reduced to a half

TA10/S	1,0 m/s2
TA10BL	2,0 m/s2
TA10BXL	2,0 m/s2

Example:

'9:92CR' Switches on automatic feed of pencil leads

Initialization of vector to start of circle

Function:

- the vector to the starting point of a circle or arc may be drawn with pen up or pen down. This makes connection to a circle easier.

Command format:

```
:A N CR
   |
   └──────── FIGURE parameter
```

where N = 1 Vector selected with pen up (default)
N = 2 Vector selected with pen down

Example:

':A2CR selects vector to starting point of cirle with pen down

Switch to manual or computer mode [':B']

Function:

- this command switches the table mode
- the command has the same priority as the manual key

Command format:

```
:B N CR
   |
   └──── FIGURE parameter
```

where N = 1 Switches to manual mode
N = 2 - if table is in manual mode: switch to tool mode
- if table is in tool mode: switch to computer mode
- if table is in computer mode: no effect
N = 3 Switches to computer mode

Conditions:

- After input of the :B command the change of mode takes place only after the last command previously entered has been executed (plotted); this corresponds to the plot idle state.

Example:

```
'UØ,ØCR'
':B1CR'
```

After plotting vectors UØ,Ø, manual mode is activated.

Initialization of autoreport [':C']

Function:

With this command, the automatic transmission of new reference and window coordinates can be initialized in the same format as by the interrogation commands <2, <3, <4.

Command format:

```
:C N CR
   |
   └──────── Parameter NUMBER
             N = 1  Transmission off (default)
             N = 2  Transmission on
```

Conditions:

Example:

':C 2 CR' switches on transmission

New coordinates are transmitted when a new reference or a window is set by software commands :0, :1 and :D or manually.

Change of coordinate system [':D'] (TA10 only)

Function:

This command is used to change the coordinate system to the horizontal A0 format. The new zero point is at top left.

Command format:

```
:D N CR
   |
   └──────── Parameter NUMBER
             N = 1  Change to normal coordinates (default)
             N = 2  Change to rotated coordinates
```

Conditions:

Switching is possible only in COMPUTER mode

Example:

':D 2 CR'	Switch to horizontal A0
'U 0, 0 CR'	Move to zero point at top left

Notes:

This command is used to interchange axial limits.
This command is used to reset window and reference.

Initialization of auto pen-lift at angular discontinuities ':E'

Function:

This command initializes the automatic pen-lift at angular discontinuities, i.e. the pen will be raised, turned to the new direction and lowered again, if the directions of two pen-down vectors differ by more than a certain limiting angle w. This procedure allows proper cutting of edges.

Command format:

:E w CR

Parameter
w = (0....18000) = angle (degrees) * 100: switches the auto pen-lift function on, with a limiting angle of w degrees.
w < 0: switches the function off

Examples:

':E2000 CR'	switch on, limiting angle = 20 degrees
':E-2000 CR'	switch the function off

1.2.4 Initialization of plotting parameters

Function:

- to change parameters for executing text, line types and circle symbols (commands M, O, F, G, H, J, V, W, X, Y)

Command format:

```
K W, M, R, I CR        W, M, R, I are FIGURE parameters
   |  |  |  |
   |  |  |  |_____ Increment number for short dash
   |  |  |________ Radius of circle
   |  |___________ Scale
   |______________ Angle
```

Conditions:

- the following ranges apply to these parameters:
  - Ø = W = 36ØØØ (for command M, see section 1.4.1)
  - Ø ≤ M ≤ 289 (for command M, see section 1.4.1)
  - Ø ≤ R ≤ 3ØØØØ (for command O, see section 1.4.2)
  - Ø ≤ I ≤ 6ØØØØ (for commands F,G,H,J,V,W,X,Y, see sections 1.3.2 and 1.4.2)

Example:

'K9ØØØ,83,1ØØ,5ØCR'

whereby
- the text written with command M would be parallel to the Y axis and 10mm high
- the circle plotted with the command O would have a radius of 2mm
- the short dash of a dashed line would be 1mm in length

1.2.5 Select plotting point

Function:

- to select required plotting point

Command format:

```
P N, CR
  |
  |_____________ FIGURE parameter
```

where N = 1 selects pen 1
N = 2 selects pen 2
N = 3 selects pen 3
N = 4 selects pen 4

Conditions:

- manual PEN selection via the function keys of the table does not affect the plotting point selected by software command
- plotting points 3 and 4 can only be selected if the quadruple plotting head (optional) is fitted

Example:

'P2CR' selects plotting point 2

1.2.6 Request for coordinates and parameters

1.2.6.1 Request command

Function:

Request:
- actual plotting-point position
- offset of actual reference relative to table reference
- minimum window coordinate
- maximum window coordinate
- status information (this is transmitted with each of the above requests)

Command format:

<N CR ——— TERMINATOR
| └——— FIGURE (command identifier)
└——— IDENTIFIER of command string

where N = 1 requests plotting-point position (relative to reference)
N = 2 requests offset of reference (absolute)
N = 3 requests minimum window coordinate (relative to reference)
N = 4 requests maximum window coordinate (relative to reference)

Example:

'<3CR' requests minimum window coordinate

Conditions:

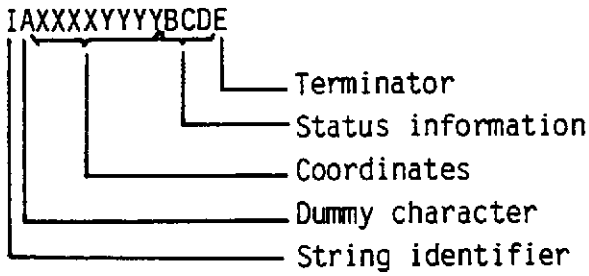
- to request status information, one of the commands (N = 1...4) must be entered; this status information is explained below in the description of the output format
- following the request ("<1"), the plotting-point position is output only after all commands have been processed (PLOT IDLE) or if the table is in MANUAL mode

1.2.6.2 Output format

Function:

- the information requested by means of the [<] command or by pressing the RECORD key (see section 2.) are output by the table via the interface, formatted in 14 characters
- the output always includes coordinates and status information

Output format:

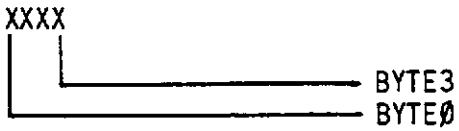


where:

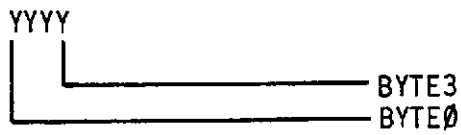
XXXX	X coordinate
YYYY	Y coordinate
B	Status 1
C	Status 2
D	Status 3
E	Terminator

Identifier

I = Ø	X and Y coordinates registered via the RECORD key of the digitizing keyboard (see section 2.)
I = 1...4	Reply to request command [<]
I = 1	Actual position of plotting point
I = 2	Reference coordinate
I = 3	Minimum window coordinate
I = 4	Maximum window coordinate
A	Dummy character @ (≙4ØH)



- X coordinate in 4-bit binary format with @ offset (≙4ØH)
- in BYTEØ, bit 4, the mathematical sign is transmitted
  bit 4 = 1 X coordinate negative



- Y coordinate in 4-bit binary format with @ offset (≙4ØH)
- in BYTEØ, bit 4, the mathematical sign is transmitted
  bit 4 = 1 Y coordinate negative

B: Status 1

Bit Ø...2 — HW-SPEED SWITCH, binary code

ØØØ ≙ 8mm/s
ØØ1 ≙ 16mm/s
Ø1Ø ≙ 32mm/s
Ø11 ≙ 64mm/s
1ØØ ≙ 128mm/s
1Ø1 ≙ 200mm/s
11Ø ≙ 259mm/s
111 ≙ 296mm/s

Bit 3 — PLOT MODE

Bit 3 = Ø processing of all vectors not yet complete
Bit 3 = 1 processing of all vectors complete (PLOT IDLE)

Bit 4 — TABLE MODE

Bit 4 = Ø table in COMPUTER MODE
Bit 4 = 1 table in MANUAL MODE

Bit 5 — SPEED CONTROL MODE

Bit 5 = Ø maximum speed is being determined by hardware (multiswitch of function keyboard)
Bit 5 = 1 maximum speed determined by software

C: Status 2

Bit Ø, 1 — PEN NUMBER, binary code

ØØ plotting point 1 is selected
Ø1 plotting point 2 is selected
1Ø plotting point 3 is selected
11 plotting point 4 is selected

Bit 2 — PEN STATUS

Bit 2 = Ø plotting point up
Bit 2 = 1 plotting point down

Bit 3 — TANGENTIAL CONTROLLER

Bit 3 = Ø tangential control disabled or incorrectly initialized
Bit 3 = 1 tangential control initialized

Bit 4 — HEAD STATUS

Bit 4 = Ø dual head fitted
Bit 4 = 1 quadruple head fitted

Bit 5 — QUALITY SWITCH

Bit 5 = Ø acceleration not reduced by quality switch
Bit 5 = 1 acceleration reduced by quality switch or automatic pencil-lead feed ($a = 2.5m/s^2$)

D: Status 3

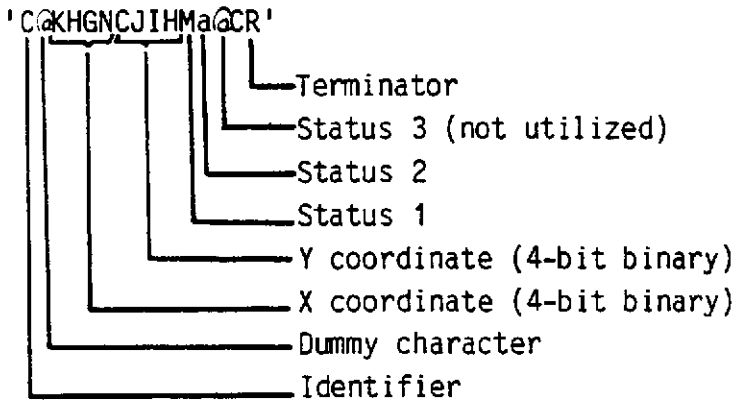
Bits Ø...5 not utilized

Conditions:

- bit 7 contains the parity bit in accordance with the transfer format
- information with the identifier I = Ø is not activated by means of a request command but by manual registration of the plotting-point position, i.e. by means of the RECORD key of the digitizing keyboard. If at that time the output buffer is not empty, the key command is ignored; if it is empty, the buzzer sounds as long as the key is kept depressed.

Example:

The output



produces:

Identifier: I = 3 Minimum window coordinate

X coordinate:

X = 'K H G N'
≙ 4BH 48H 47H 4EH
-4ØH -4ØH -4ØH -4ØH @offset
ØBH 8H 7H ØEH

≙ ØB87EH
X ≙ 47230

Y coordinate:

Y = 'C J I H'
≙ 43H 4AH 49H 48H
-4ØH -4ØH -4ØH -4ØH @offset
3H ØAH 9H 8H

≙ 3A98H
Y ≙ 15ØØØ

Status 1:

A = '-'

≙ 2DH
-2ØH

≙ ØDH

≙ ØØØØ1101B

- HW speed = 128mm/s
- PLOT IDLE
- COMPUTER MODE
- Speed is controlled by HW

Status 2:

B = 'A'

≙ 41H
-2ØH

≙ 21H

≙ ØØ1ØØØØ1B

- Plotting point 2 is selected
- Plotting point raised
- Tangential control disabled
- Dual head
- QUALITY switch ON (2.5m/s^2)

1.2.7 Select SW manual mode

Function:

- to switch over from computer to SW manual mode
- any subsequent control command entered switches back to computer mode

Command format:

N CR

- TERMINATOR
- IDENTIFIER

Conditions:

- after input of the N command, switching to the SW manual mode takes place only after the last command previously entered has been executed (plotted); this corresponds with the PLOT IDLE state
- the command is executed only once the table is no longer in the hardware-selected manual mode (MANUAL key)

Example:

1 the table is operating in computer mode; the control command
'NCR'
is then given
2 the table first executes the commands entered previously
3 if the light barrier is activated (interrupted) or the MAN/STOP key pressed, the table switches over to manual mode
4 if the MANUAL key is pressed, the table switches over to computer mode and executes and processes all commands (→ PLOT IDLE)
5 the table executes the N command (→ SW manual mode)
6 the table again switches over to computer mode when the next character is written into the input buffer

1.3 Vector commands

The actual position of the plotting point is connected by a straight line with the target position given in the command. The information of the target position may be given as an absolute value (relative to the reference point) or relative to the actual position.

The vector movements can be executed with the plotting point either raised or lowered. It is also possible to plot vectors with line patterns.

Depending on the type of command, the data are transmitted either in ASCII format (FIGURE parameters) or in binary format (4-bit, 8-bit or SHORT parameters).

1.3.1 Absolute vectors

Function:

- to connect actual position with the absolute target position given in the command

Command format:

```
U X, Y CR   Line with plotting point up
D X, Y CR   Line with plotting point down
| | | |└──TERMINATOR
| | |└────FIGURE parameters for X and Y coordinates
| |└──────
|└────────IDENTIFIER
```

Conditions:

- for X and Y, the following applies:
Ø ≤X, Y ≤6ØØØØ increments

Example:

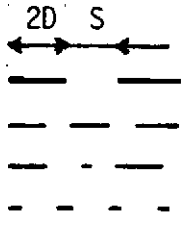
'D1ØØØ,15ØØØCR'
connects the actual position with the target position by a continuous straight line

Target position:

X = 1000 increments = 1000 x 0.02mm = 20mm
Y = 15000 increments = 15000 x 0.02mm = 300mm

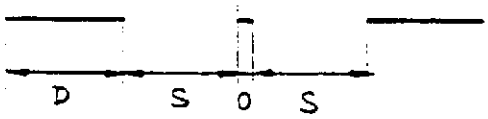
1.3.2 Absolute vectors with line pattern

The following four line patterns can be generated:



Command	'V'	long-dashed line
	'W'	short-dashed line
	'Y'	dot-dashed line
	'X'	dotted line

The following dimensional proportions apply:



D dash	dash length in table increments (0.02mm)
S space	the space is generally identical with the dash length but may be longer if a length adjustment is required
O dot	the dot is 1/10 of the dash length

The long dash of the 'V' command is two dashes long

The dash length D is given during initialization ('K' command, see section 1.2.4), thus defining the length of the other elements

The default value for the dash length is 5mm

Note:

These definitions also apply to circles and segments of circles (see section 1.4.4).

Command description

Function:

- to connect the actual position with the absolute target position given in the command by one of the four line types
- the line always begins and ends with plotting point down

Command format:

V X, Y CR	long-dashed line
W X, Y CR	short-dashed line
X X, Y CR	dotted line

```
Y X, Y CR   dot-dashed line
| |  |
| |  └──TERMINATOR
| └─────FIGURE parameter for X and Y coordinate
└───────IDENTIFIER
```

Conditions:

- see section 1.3.1, absolute vectors
- if the vector length is less than the pattern length, a continuous line is plotted

1.3.3 Relative vectors

Function:

- to connect the actual position with the target position given in the command relative to the actual position

Command format:

```
B X, Y CR   Line with plotting point up
A X, Y CR   Line with plotting point down
  | |
  └─┴─────FIGURE parameters for the relative X and Y values
```

Conditions:

- for X and Y, the following applies:
  Ø ≤ X, Y ≤6ØØØØ increments

Example:

'B2ØØØ,-1ØØØØ

Connects the actual position with a target position which is 40mm positive in X and 200mm negative in Y relative to it

1.3.4 Absolute 4-bit binary vectors

Function:

- to connect the actual position with the absolute target position given in the command

Command format:

```
@ X Y CR    Line with plotting point up
? X Y CR    Line with plotting point down
  | |
  └─┴─────4-bit parameters for X and Y coordinates
```

Conditions:

- see structure of 4-bit binary parameters, section 1.1.1

Example:

```
'?&##)-"/*(CR'
     |    |
     |    └──────4-bit parameter of Y coordinate
     └───────────4-bit parameter of X coordinate
```

Hence we obtain

X = 2550 1 increments
Y = 1220Ø increments

1.3.5 Absolute 8-bit binary vectors

Function:

- to connect actual position with the absolute target position given in the command

Command format:

```
>X Y CR      Line with plotting point up
=X Y CR      Line with plotting point down
  |
  └──────8-bit parameters for X and Y coordinates
```

Conditions:

- see structure of 8-bit binary parameters (section 1.1.1)
- when this format is being used, work must not be carried out with SW protocol
- interface must be set to 8 data bits

Example:

```
'=~!(##CR'
   |  |
   |  └──────8-bit parameter of Y coordinate
   └─────────8-bit parameter of X coordinate
```

Hence we obtain

X = 32289 increments
Y = 1Ø275 increments

1.3.6 Short vectors (relative, binary)

Function:

- to connect the actual position with the target position given relative to it

Command format:

S X Y CR Short vector with plotting point up
T X Y CR Short vector with plotting point down

SHORT parameters for X and Y coordinates

Conditions:

- see structure of SHORT parameters (section 1.1.1)
- if this format is used, work must not be carried out simultaneously with SW protocol

Example:

'S6X+%CR'

SHORT parameter for Y coordinate
SHORT parameter for X coordinate

Hence we obtain

X = 7ØØØ increments
Y = 5541 increments

1.4 Text, symbols, circles

The TA 2 has three character sets:

- standard ASCII set
- European character set (ASCII set with special European characters)
- photogrammetry character set (capital letters with special symbols)

In addition, it is also possible to generate circles and segments of circles with the five available line types from the TA 2 internally

1.4.1 Character sets

Function:

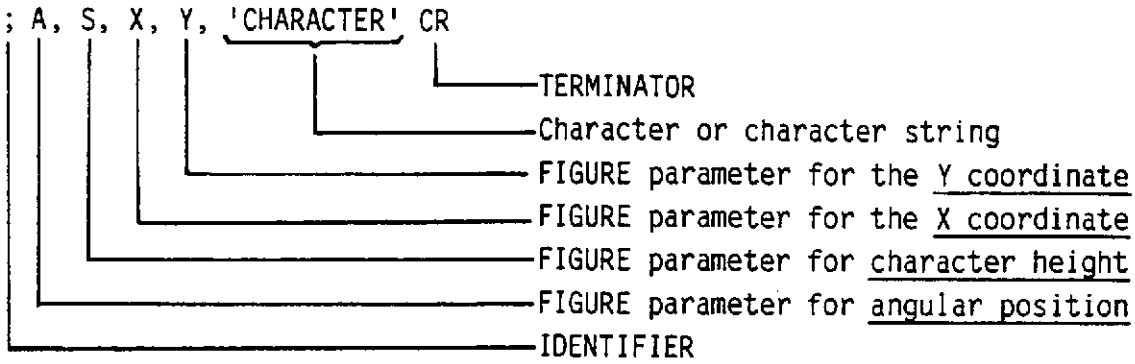
- the TA 2 generates the characters contained in the character string of the command
- angular position, height and starting point of the character string can be defined
- the characters are defined in a 5 x 8 matrix

The [';'] command

Function:

- generates the characters that are defined by the character set selected (see section 1.2.3, initialization of plotting-table parameters)

Command format:



Conditions:

- for the angular position A, A = 1ØØ x a, with Ø ≤a ≤360°
- for the character height S, S = 8.33 x s, with Ø ≤s ≤34.6mm
  Ø ≤S ≤289
- the X,Y coordinates determine the starting point for the first character and refer to the lower left corner of capital letters
- the control characters (characters <2ØH) are represented by a blank character; they must not be used with the SW-interface protocol
- in the case of some of the characters in the European character set, no offset is plotted to the next character, so that characters may be combined

Example:

```
';15ØØ,83,5ØØ,5ØØ,AVIOTAB TA2CR'
```

AVIOTAB TA10

After switching over to the European character set by ':42CR', the command

';Ø,42,5ØØ,5ØØ,H{ohleCR'

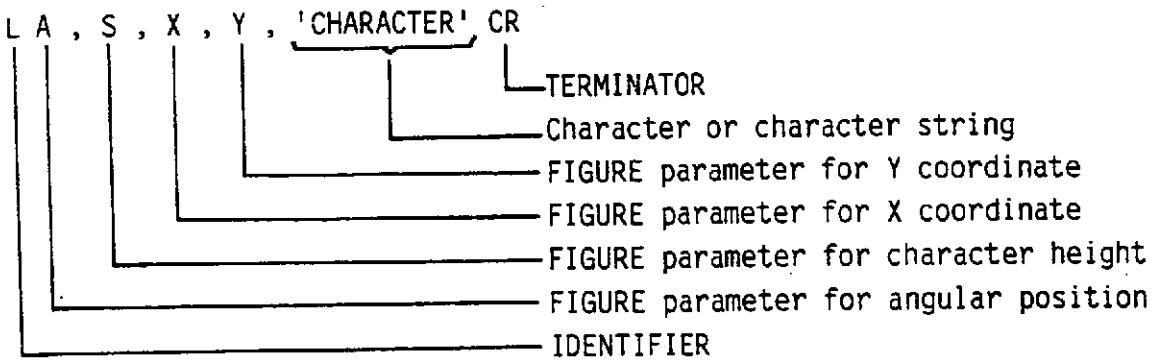
produces the following text:

The ['L'] command

Function:

- to generate only the characters of the photogrammetry character set

Command format:

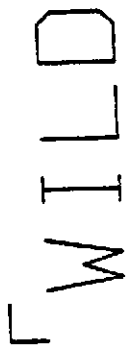


Conditions:

- for the angular position A, A = 1ØØ x a, with Ø ≤a ≤360°
- for the character height s, S = 8.33 x s, with Ø <s ≤34.6mm
  Ø <S ≤289
- the X,Y coordinates determine the starting point for the first character and refers to the centre of the character for capital letters
- the control characters are represented by a blank character and must not be used with the SW-interface protocol

Example:

'L9ØØØ,83,5ØØ,5ØØ,WILD CR'

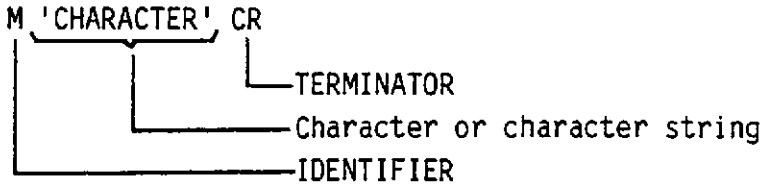


The ['M'] command

Function:

- similar to ['L'] command for generating the photogrammetry character set
- angular position and character height are determined by the ['K'] command (see section 1.2.4)
- the centre of the first character is the actual plotting-point position

Command format:



Conditions:

- the plotting point remains in position at the end of the character string
- the control characters are represented by a blank character and must not be used with the SW-interface protocol

Example:

The commands

'U5ØØ,5ØØCR' and 'MzCR'

produce:

TA10-CHARACTER SETS

DEZ	HEX	ASCII	PHOTO	EUROP
32	20			
33	21	!	!	!
34	22	"	"	"
35	23	#	#	£
36	24	$	$	£
37	25	%	%	%
38	26	&	&	&
39	27	'	'	'
40	28	(	(	(
41	29	)	)	)
42	2A	*	*	*
43	2B	+	+	+
44	2C	,	,	,
45	2D	-	-	-
46	2E	.	.	.
47	2F	/	/	/
48	30	0	0	0
49	31	1	1	1
50	32	2	2	2
51	33	3	3	3
52	34	4	4	4
53	35	5	5	5
54	36	6	6	6
55	37	7	7	7
56	38	8	8	8
57	39	9	9	9
58	3A	:	:	:
59	3B	;	;	;
60	3C	<	<	¤
61	3D	=	=	=
62	3E	>	>	□
63	3F	?	?	?
64	40	@	@	Ø
65	41	A	A	A
66	42	B	B	B
67	43	C	C	C
68	44	D	D	D
69	45	E	E	E
70	46	F	F	F
71	47	G	G	G
72	48	H	H	H
73	49	I	I	I
74	4A	J	J	J
75	4B	K	K	K
76	4C	L	L	L
77	4D	M	M	M
78	4E	N	N	N
79	4F	O	O	O

DEZ	HEX	ASCII	PHOTO	EUROP
80	50	P	P	P
81	51	Q	Q	Q
82	52	R	R	R
83	53	S	S	S
84	54	T	T	T
85	55	U	U	U
86	56	V	V	V
87	57	W	W	W
88	58	X	X	X
89	59	Y	Y	Y
90	5A	Z	Z	Z
91	5B	[	[	⊔
92	5C	\	\	Ç
93	5D	]	]	Æ
94	5E	↑	↑	^
95	5F	←	←	´
96	60	°	°	`
97	61	a	Ω	a
98	62	b	≡	b
99	63	c	\//	c
100	64	d	//	d
101	65	e	Λ	e
102	66	f	⊠	f
103	67	g	□	g
104	68	h	⧖	h
105	69	i	△	i
106	6A	j	◊	j
107	6B	k	⏚	k
108	6C	l	⊞	l
109	6D	m	⏃	m
110	6E	n	⊕	n
111	6F	o	◇	o
112	70	p	⊡	p
113	71	q	⏀	q
114	72	r	△	r
115	73	s	+	s
116	74	t	×	t
117	75	u	⌔	u
118	76	v	⏄	v
119	77	w	⧖	w
120	78	x	Z	x
121	79	y	Y	y
122	7A	z	⌑	z
123	7B	{	✳	¯
124	7C	¦	⧖	¨
125	7D	}	|	~
126	7E	~	⏄	
127	7F			

1.4.2 Circles and circular arcs

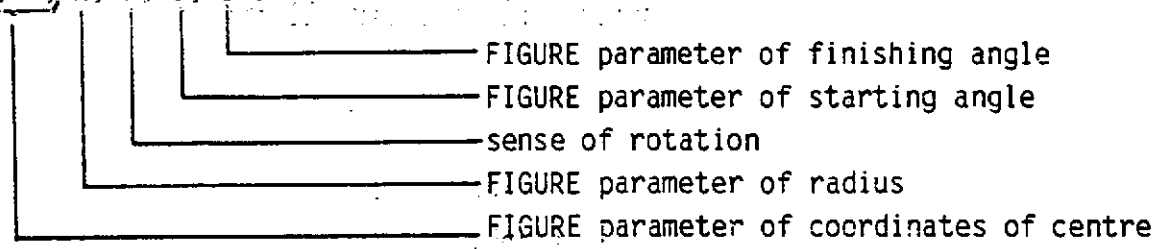
Long format

Function:

- to plot circles and circular arcs with continuous line or one of the four other line patterns
- the coordinate of the centre, the radius, the sense of rotation, and the starting and finishing angles may be given

Command format:

E X, Y, R, D, S, E CR	continuous line
F X, Y, R, D, S, E CR	long-dashed line
G X, Y, R, D, S, E CR	short-dashed line
H X, Y, R, D, S, E CR	dotted line
J X, Y, R, D, S, E CR	dot-dashed line



Conditions:

- Centre coordinates	Ø ≤X,Y ≤6ØØØØ increments
- Radius	Ø ≤R ≤6ØØØØ increments
- Sense of rotation	D = 'A' anticlockwise rotation D = 'C' clockwise rotation
- Starting angle	Ø ≤S ≤n x 1ØØ
- Finishing angle	Ø ≤S ≤n x 1ØØ, with Ø ≤n ≤360°, n = Ø° is the positive X direction

- starting and finishing angles may be omitted; in that event a full circle will be plotted
- if the sense of rotation is not given, the default value is adopted (clockwise rotation); in this case, however, starting and finishing angles must also be omitted

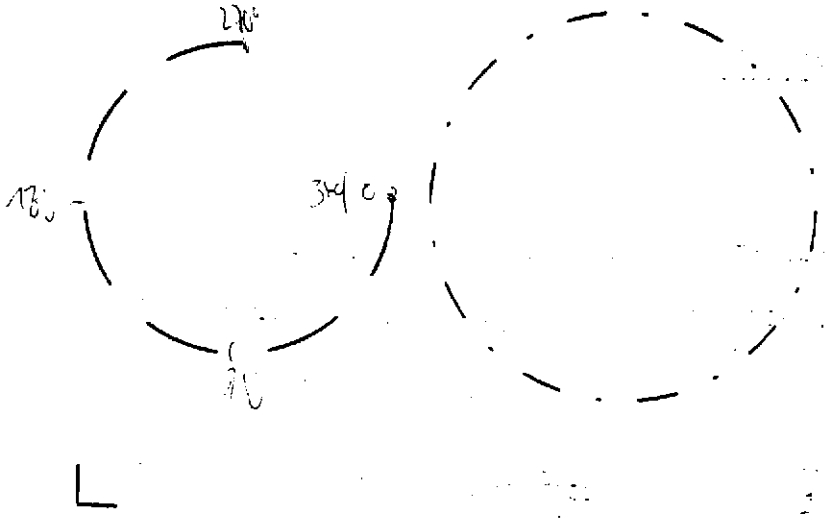
Example:

' F1ØØØ,2ØØØ,1ØØØ,C,Ø,9ØØØCR'

plots a short-dashed circular arc with the centre coordinates X = 20mm, Y = 40mm and a radius R = 20mm; the arc encloses an angle of 270°, i.e. from 0° to 90° clockwise

'J35ØØ,2ØØØ,125ØCR'

plots a dot-dashed circle with the centre coordinates X = 70mm, Y = 40mm and R = 25mm



Short format for circles

Function:

- to plot circles with a continuous line, the central coordinate and radius being given

Command format:

C X, Y, R, D CR

D — Sense of rotation

X, Y — FIGURE parameters of central coordinates

Conditions:

- centre coordinates Ø ≤X,Y ≤6ØØØ increments
- radius Ø ≤R ≤3ØØØ increments
  for R = Ø, a point is plotted
- sense of rotation 'A' (anticlockwise) or 'C' (clockwise) may be omitted

Example:

'C3ØØØØ,3ØØØØ,3ØØØØCR'

plots a circle with its centre at the centre of the table, having the maximum possible radius of R = 600mm

Circular symbol

Function:

- to plot a circular symbol with its centre at the actual plotting-point position; the radius is predefined with the plotting parameters ('K' command, see section 1.2.4)

Command format:

OCR

Conditions:

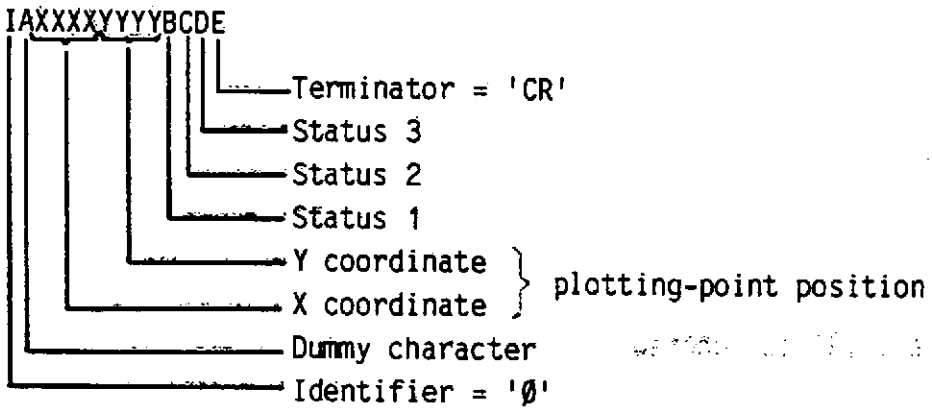
- if the plotting parameters are not defined with the 'K' command, the default values apply

2. Coordinate registration with the RECORD key

Function:

- to register the actual plotting-point position and output via the RS 232 interface (see part C, section 2.3)
- table-status information is provided at the same time

Output format:



For further details, see section 1.2.6.2 'output format'.

Conditions:

- if the registration has been accepted (output buffer is empty when key is pressed), this is confirmed by the buzzer as long as the RECORD key is pressed

Comment ']'

Function:

This command is used to insert comments in plot files, i.e. all characters up to the next carriage return (ODH) are ignored.

Command format:

```
] comment CR
  └─any characters
```

Conditions: — —

Example:

'] This is a comment CR' is ignored

With roll feed

Programmable length

Function:

Feed length determined by a feed command, in mm.

Format:

```
]XXXXCR
│└──┘└┘
│  │  └── Terminator
│  └───── Feed length in mm (4 digits)
└──────── Identifier
```

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