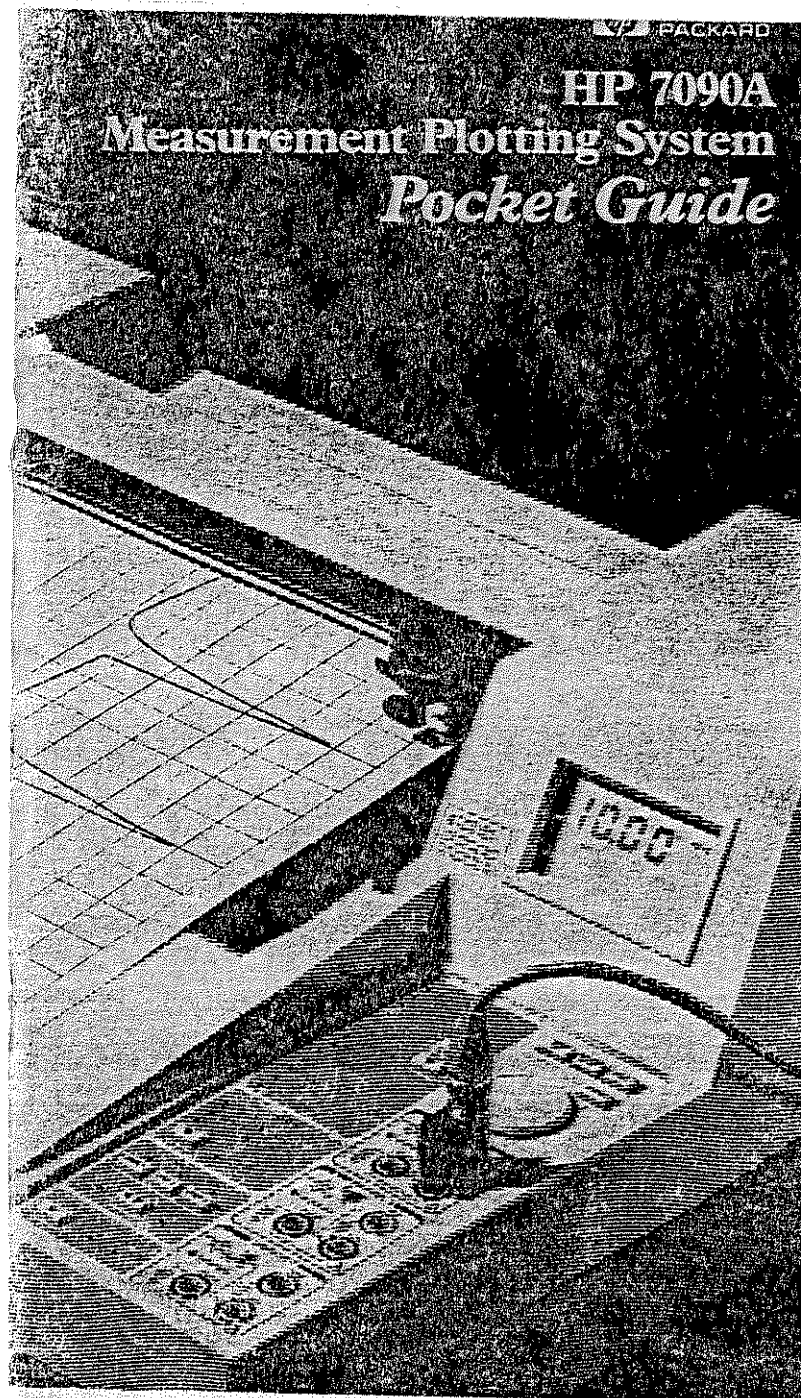




How To Use This Guide

This pocket guide lists the formal syntax for each instruction in alphabetical order of the instruction's two-letter mnemonic. The HP-RL recorder instructions are listed first, followed by HP-GL plotter instructions. Also included are no operation (NOP) instructions, plotter and recorder default conditions, default coordinates for limits and scaling points, and HP-GL/HP-RL error messages.

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Each instruction is listed with its syntax, purpose, parameter or response type, range, and default condition. Omitting a parameter sets the default condition unless otherwise noted. A semicolon is included as the terminator for all instructions except the HP-GL label instruction, *LB*. The ASCII carriage return and line feed characters (CRLF) are sent at the end of all output responses.

HP-RL INSTRUCTIONS

DG Draw Grid

DG grid type; or *DG*;

Purpose: Draws grid. Omitting parameter defaults to user-defined grid defined by *GL* instruction.

Parameter	Format	Range	Default
grid type	integer	0 = user-defined grid 1 = centimetre grid	0

DO Set Data Output

DO channel(s), # of samples, format, trigger status; or *DO*;

Purpose: Defines format for output of data samples following *QD* or *QI* instructions. Omitting parameters defaults to default conditions listed below.

Parameter	Format	Range	Default
channel(s)	integer	0 = channels 1, 2, and 3 1 = channel 1 2 = channel 2 3 = channel 3	0
# of samples	integer	0 to 32 767 0 = continuous sampling	0
format	integer	0 = ASCII 1 = binary	0
trigger status	integer	0 = no trigger status 1 = send trigger status	0

GL Set Grid Divisions

GL X-axis divisions, Y-axis divisions (, quadrants); or *GL*;

Purpose: Specifies number of user-defined grid divisions and quadrants to receive grid when *DG* instruction is executed.

Parameter	Format	Range	Default	
			A/A4	B/A3
X-axis divisions	integer	1 to 100	25	38
Y-axis divisions	integer	1 to 100	18	25
quadrant	integer	1 to 15	1	1

IR Set Full Scale Range

IR FS1 (, FS2, FS3); or *IR*;

Purpose: Sets input channel ranges.

Parameter	Format	Range	Default
volts	real	0.0050 V to 100.0 V	10.0 V

IT Set Real-Time Clock

IT year, month, day, hours, minutes;

Purpose: Sets time and date of real-time clock. Seconds are set to zero when *IT* instruction is executed.

Parameter	Format	Range	Default
year	integer	0 to 99	none
month	integer	1 to 12	
	or character	or JAN to DEC	
day	integer	1 to 31	
hour	integer	0 to 23	
minutes	integer	0 to 59	

IZ Set Zero and Full Scale

IZ $Z_X, Z_Y (FS_X, FS_Y)$; or *IZ*;

Purpose: Sets location of zero and full-scale points. Omitting parameters sets points to default locations.

Parameter	Format	Range	Default
X, Y coordinates	integer	-32 768 to 32 767	Dependent on paper size

MS Measurement Start

MS measurement; or *MS*;

Purpose: Initiates measurement.

Parameter	Format	Range	Default
measurement type	integer	0 = direct recording 1 = buffered recording	0

MT Measurement Terminate

MT;

Purpose: Terminates measurement or data acquisition mode.
No parameter required.

PL Plot Buffer

PL;

Purpose: Plots buffer contents for selected channel(s). No parameter required.

QA Query Trigger Level and Width

QA;

Purpose: Outputs current trigger level and width voltages, and validity of values (0 = valid, 1 = invalid).

Response: level, width, validity CRLF

QB Query Total Time

QB;

Purpose: Outputs value of current total time selection.

Response: time, units CRLF

where: time = 0.030 to 100 (s) units = 0 (s)
 1.00 to 100 (min) 1 (min)
 1.00 to 24.0 (h) 2 (h)

QC Query Channel Status

QC;

Purpose: Outputs decimal value (0 to 255) of channel status byte in ASCII.

Response: channel status CRLF

QD Query Direct A/D Data Sample

QD;

Purpose: Initiates data streaming from A/D converters to computer (data acquisition mode).

Response: Outputs number of samples specified by *DO* instruction at rate specified by *SD* instruction.

QG Query Post-/Pre-Trigger Time

QG;

Purpose: Outputs the currently requested post- or pre-trigger time, and the validity of the time value (0 = valid, 1 = invalid).

Response: time, units, validity CRLF

where: time = $\pm$ (0.00 to 100) (s) units = 0 (s)
 $\pm$ (1.00 to 100) (min) 1 (min)
 $\pm$ (1.00 to 24) (h) 2 (h)

QI Query Buffered A/D Data Sample

QI;

Purpose: Initiates transfer of channel buffer contents to computer.

Response: Outputs number of samples specified by *DO* instruction (*SD* instruction is ignored).

QL Query Grid Divisions

QL;

Purpose: Outputs current number of user-defined grid divisions and quadrants to receive grid.

Response: X-axis divisions, Y-axis divisions, quadrants
CRLF

QM Query Recording Mode

QM;

Purpose: Outputs current definitions of X- and Y-axes of recording area.

Response: mode CRLF

QR Query Full Scale Range

QR;

Purpose: Outputs current range settings for all channels.

Response: range 1, range 2, range 3 CRLF

QS Query Recorder Status

QS;

Purpose: Outputs decimal value (0-255) of recorder status byte in ASCII.

Response: recorder status CRLF

QT Query Trigger Mode

QT;

Purpose: Outputs currently selected trigger mode.

Response: mode, option CRLF

where: mode = 0 (manual) option = 0 (above level)
 1 (external) 1 (below level)
 2 (internal) 2 (inside window)
 3 (outside window)

QU Query Trigger Time

QU;

Purpose: Outputs time of last trigger occurrence.

Response: hours, minutes, seconds CRLF

where: hours = 0 to 23
 minutes = 0 to 59
 seconds = 0 to 59

QV Query DC Offset

QV;

Purpose: Outputs requested channel offset value(s) and validity (0 = valid, 1 = invalid).

Response: offset1, offset2, offset3, validity CRLF

QW Query Real-Time Clock

QW;

Purpose: Outputs current time and date of real-time clock.

Response: year, month, day, hours, minutes, seconds
CRLF

where: year = 00 to 99
 month = 01 to 12
 day = 01 to 31
 hours = 00 to 23
 minutes = 00 to 59
 seconds = 00 to 59

QZ Query Zero and Full Scale

QZ;

Purpose: Outputs current X- and Y-coordinates of zero and full-scale points.

Response: Z_X, Z_Y, FS_X, FS_Y CRLF

RE Set Recording Mode

RE mode; or *RE*;

Purpose: Defines X- and Y-axes of recording area in terms of input channels and/or time. Omitting parameter defaults to channel 1 vs. time.

Parameter	Format	Range	Default
mode	integer	3 through 15 except 6, 10, and 14	9

RL Remote/Local

RL state; or *RL*;

Purpose: Enables or disables front-panel controls.

Parameter	Format	Range	Default
state	integer	0 = local state 1 = remote state	0

SD Set Sample Delay

SD time; or *SD*;

Purpose: Sets time interval between samples, or sample sets, for data transfers initiated by *QD* instruction.

Parameter	Format	Range	Default
time	real	0.002 to 1000 s	0.1 s

SV Set DC Offset

SV offset1 (, offset2, offset3); or *SV*;

Purpose: Sets zero voltage position of each channel's input signal.

Parameter	Format	Range	Default
volts (offset)	real	-100 to 100 V	0.0 V

TA Set Trigger Level and Width

TA level(, width); or *TA*;

Purpose: Specifies trigger level and width for internal triggering.

Parameter	Format	Range	Default
level	real	-200 to 200 V	0.0 V
width	real	0 to 200 V	0.0 V

TB Set Total Time

TB Time (, units); or *TB*;

Purpose: Specifies total time setting.

Parameter	Format	Range	Default
time	real	0.030 s to 24.0 h	1
units	integer	0 = seconds 1 = minutes 2 = hours	0

TD Label Time and Date

TD label type; or *TD*;

Purpose: Label current setup conditions, current time and date, and/or time of the trigger occurred.

Parameter	Format	Range	Default
label type	integer	0 = time and date 1 = time 2 = date 3 = trigger time 4 = setup conditions	0

TG Set Post-/Pre-Trigger

TG time (,units); or *TG*;

Purpose: Specifies post- or pre-trigger time setting.

Parameter	Format	Range	Default
time	real	$\pm(0.00 \text{ to } 100) \text{ (s)}$ $\pm(1.00 \text{ to } 100) \text{ (min)}$ $\pm(1.00 \text{ to } 24.0) \text{ (h)}$	0
units	integer	0 = seconds 1 = minutes 2 = hours	0

TM Set Trigger Mode

TM mode (,options); or *TM*;

Purpose: Selects trigger mode.

Parameter	Format	Range	Default
mode	integer	0 = manual 1 = external 2 = internal	0
options	integer	0 = above level 1 = below level 2 = inside window 3 = outside window	0

XS Set Plotter or Recorder Status

XS status type; or *XS*;

Purpose: Selects plotter status byte (*OS*) or recorder status byte (*QS*) as HP-IB status byte.

Parameter	Format	Range	Default
status byte	integer	0 = plotter 1 = recorder	0

HP-GL INSTRUCTIONS

CA Designate Alternate Character Set

CA set number; or CA;

Purpose: Designates alternate character set.

Parameter	Format	Range	Default
set number	integer	0 to 4	0

CP Character Plot

CP spaces, lines; or CP;

Purpose: Moves pen the number of spaces and lines specified. Omitting parameters causes carriage return and line feed.

Parameter	Format	Range	Default
spaces	real	-128.0000 to 127.9999	Carriage return point
lines	real	-128.0000 to 127.9999	

CS Designate Standard Character Set

CS set number; or CS;

Purpose: Designates standard character set.

Parameter	Format	Range	Default
set number	integer	0 to 4	0

DF Default

DF;

Purpose: Returns certain plotter functions to default conditions (see table of Plotter Default Conditions).

DI Absolute Direction

DI run, rise; or *DI*;

Purpose: Sets direction of labels. At least one parameter must be effectively nonzero; i.e., ≤ 0.0004 .

Parameter	Format	Range	Default
run	real	-128.0000 to 127.9999	1
rise	real	-128.0000 to 127.9999	0

DR Relative Direction

DR run, rise; or *DR*;

Purpose: Sets direction of labels. Omitting parameters causes horizontal labels. Run is % of $P2X - P1X$, rise is % of $P2Y - P1Y$.

Parameter	Format	Range	Default
run	real	-128.0000 to 127.9999	1
rise	real	-128.0000 to 127.9999	0

DT Define Terminator

DT terminator;

Purpose: Defines character that terminates label mode.

Parameter	Format	Range	Default
terminator	character	ASCII characters with decimal values 1 through 127	ETX (decimal value 3)

IM Input Mask

IM E-mask (, S-mask, P-mask); or *IM*;

Purpose: Controls conditions under which HP-RL and HP-GL error status is reported, conditions that can cause an HP-IB service request message, and conditions that can cause a positive response to an HP-IB parallel poll.

Parameter	Format	Range	Default
E-mask	integer	0 to 255	233
S-mask	integer	0 to 255	0
P-mask	integer	0 to 255	0

IN Initialize

IN;

Purpose: Sets plotter functions as for the *DF* instruction; in addition, sets certain recorder functions to predefined states (see table of Recorder Default Conditions). Also — the pen is raised, any error is cleared, plotter status byte is selected as the HP-IB status byte and bit position 3 set true, channel buffers are flushed, rotation is set to 0° and all limits and scaling points are set to default coordinate values for current paper-size selection.

IP Input P1 and P2

IP P1_X, P1_Y (, P2_X, P2_Y); or *IP*;

Purpose: Sets P1/P2 scaling points. Omitting parameters sets P1 and P2 to default coordinates for current paper size. Defaults to hard-clip limit coordinates if parameter is outside current hard-clip limit.

Parameter	Format	Range	Default
X, Y coordinates	integer	−32 768 to 32 767	dependent on paper size

IW Input Window

IW X_{LL}, Y_{LL}, X_{UR}, Y_{UR}; or *IW*;

where: LL = lower left, UR = upper right

Purpose: Sets input window (soft-clip limits). Omitting parameters sets window area to default coordinate values for current paper size.

Parameter	Format	Range	Default
X, Y coordinates	integer	−32 768 to 32 767	dependent on paper size

LB Label

LB c...ct

where: *c* is an ASCII character and *t* is the label terminator defined by *DT*. Default is ETX, decimal equivalent 3.

Purpose: Draws character string using current character set.

Parameter	Format	Range	Default
ASCII character	character	all ASCII characters	off

LO Label Origin

LO position number; or *LO*;

Purpose: Positions labels relative to current pen position.

L03	L06	L09
L02	L05	L08
L01	L04	L07
L013	L016	L019
L012	L015	L018
L011	L014	L017

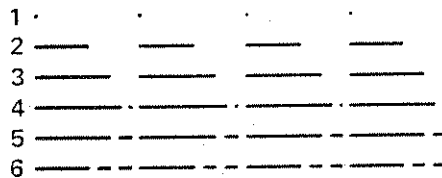
LT Line Type

LT pattern number (, pattern length); or LT;

Purpose: Sets line type used for drawing lines.

Parameter	Format	Range	Default
pattern number	real	-128.0000 to 127.9999 (0 to 6, useful range)	solid line
pattern length	real	-128.0000 to 127.9999	4% of diagonal P2-P1

0 Specifies dots only at the points that are plotted.



One pattern length
No parameter (Default Value) —

OA Output Actual Position and Pen Status

OA;

Purpose: Outputs pen's physical position.

Response: X, Y, P CRLF

where: X and Y are in plotter units; P is pen status (0 = up, 1 = down).

OC Output Commanded Position and Pen Status

OC;

Purpose: Outputs pen's logical position and status.

Response: X, Y, P CRLF

where: X and Y are in plotter units if scaling is off, or user units if scaling is on; P is pen status (0 = up, 1 = down).

OE Output Error

OE;

Purpose: Outputs first HP-RL or HP-GL error number.

Response: error number CRLF

where: error number is positive ASCII integer, 0 through 8 except 4 and 7.

OF Output Factors

OF;

Purpose: Outputs number of plotter units per millimetre in each axis.

Response: 40,40 CRLF

OH Output Hard-Clip Limits

OH;

Purpose: Outputs lower-left (LL) and upper-right (UR) coordinates of hard-clip limits in plotter units.

Response: X_{LL}, Y_{LL}, X_{UR}, Y_{UR} CRLF

OI Output Identification

OI;

Purpose: Outputs instrument model number (ASCII string).

Response: 7090A CRLF

OO Output Options

OO;

Purpose: Outputs instrument's capabilities.

Response: 0, 1, 0, 0, 0, 0, 0 CRLF

└ indicates pen select capability is included

OP Output P1 and P2

OP;

Purpose: Outputs coordinates of P1 and P2 in plotter units.

Response: P1_X, P1_Y, P2_X, P2_Y CRLF

OS Output Plotter Status

OS;

Purpose: Outputs ASCII decimal equivalent value (0 to 255) of plotter status byte.

Response: plotter status CRLF

OW Output Window

OW;

Purpose: Outputs plotter unit coordinates of lower-left (LL) and upper-right (UR) corners of current window.

Response: X_{LL}, Y_{LL}, X_{UR}, Y_{UR} CRLF

OY Locate Syntax Error

OY;

Purpose: Outputs the sixteen characters received immediately prior to HP-RL or HP-GL error.

Response: ASCII character string

OZ Output Command String

OZ;

Purpose: Outputs "OZ" and the fourteen characters received immediately before OZ was issued. (Carriage return and line feed characters not included.)

Response: ASCII character string

PA Plot Absolute

PA X_1 coordinate, Y_1 coordinate(, X_2 coordinate, Y_2 coordinate, ..., X_n coordinate, Y_n coordinate); or *PA*;

Purpose: Plots to X,Y coordinates in order listed using current pen up/down state. *PA*; sets absolute plotting. Coordinate pairs represent plotter units if scaling is off, user units if off.

Parameter	Format	Range	Default
X, Y coordinate(s)	integer	-32768 to 32767	none

PD Pen Down

PD; or *PD* $X, Y(\dots)$;

Purpose: Lowers pen. Parameters may be included as in *PA* or *PR*.

Parameter	Format	Range	Default
X, Y coordinate(s)	integer	-32768 to 32767	none

PR Plot Relative

PR X_1 increment, Y_1 increment (, X_2 increment, Y_2 increment, ..., X_n increment, Y_n increment); or *PR*;

Purpose: Plots to points indicated by the X,Y increments, relative to previous position. *PR*; sets relative plotting for *PU* or *PD* with parameters.

Parameter	Format	Range	Default
X, Y increments	integer	-32768 to 32767	none

PS Paper Size

PS paper size;

Purpose: Toggles between A and B, or A3 and A4 paper sizes.

Parameter	Format	Range	Default
paper size	integer	0 to 3 = B/A3-size 4 to 127 = A/A4-size	none

PU Pen Up

PU; or *PU* X,Y(...);

Purpose: Raises pen. Parameters may be included as in *PA* or *PR*.

Parameter	Format	Range	Default
X, Y coordinate(s)	integer	-32 768 to 32 767	none

RO Rotate Coordinate System

RO angle; or *RO*;

Purpose: Rotates coordinate systems 90°.

Parameter	Format	Range	Default
angle	integer	0° = normal 90° = rotated	0

SA Select Alternate Set

SA;

Purpose: Selects alternate character set designated by *CA* instruction as set to be used for subsequent labeling.

SC Scale

SC X_{min}, X_{max}, Y_{min}, Y_{max}; or *SC*;

Purpose: Scales plotting area into user units. Omitting parameters cancels scaling, and parameters of plot instruction are subsequently interpreted as plotter units.

Parameter	Format	Range	Default
X, Y coordinate(s)	integer	-32 768 to 32 767	plotter units

SI Absolute Character Size

SI width,height; or *SI*;

Purpose: Sets character width and height in centimetres.
Omitting parameters defaults character size based on paper size.

Parameter	Format	Range	Default	
			A/A4	B/A3
width	real	-128.0000 to 127.9999	0.187	0.285
height	real	-128.0000 to 127.9999	0.269	0.375

SL Character Slant

SL $\tan \theta$; or *SL*;

Purpose: Establishes slant for labeled characters. Omitting parameter defaults to no slant.

Parameter	Format	Range	Default
$\tan \theta$	real	-128.0000 to 127.9999	0

SM Symbol Mode

SM character; or *SM*;

Purpose: Draws single character centered at end of each plotted vector. Omitting parameter cancels symbol mode.

Parameter	Format	Range	Default
ASCII character	character	ASCII 33 through 126 except 59	off

SP Select Pen

SP pen number; or *SP*;

Purpose: Selects or stores pen. Omitting parameter (or parameter = 0) stores pen.

Parameter	Format	Range	Default
pen number	integer	0 to 6	0

SR Relative Character Size

SR width,height; or SR;

Purpose: Specifies size of characters and symbols as percentage of distance between P1 and P2.

Parameter	Format	Range	Default
width	real	-128.0000 to 127.9999	0.75
height	real	-128.0000 to 127.9999	1.5

SS Select Standard Set

SS;

Purpose: Selects standard character set designated by the CS instruction as set used for subsequent labeling.

TL Tick Length

TL tp,(tn); or TL;

Purpose: Establishes length of ticks drawn with XT and YT. Omitting parameters defaults *tp* (tick positive: above X-axis, to right of Y-axis) and *tn* (tick negative: below X-axis, to left of Y-axis) to 0.5% of $P2_Y - P1_Y$ for XT and 0.5% of $P2_X - P1_X$ for YT.

Parameter	Format	Range	Default
tp, tn	real	-128.0000 to 127.9999	as described above

VS Velocity Select

VS pen velocity; or VS;

Purpose: Specifies pen speed for plotting and labeling operations.

Parameter	Format	Range	Default
pen velocity	real	0 to 127.9999 cm/s	75 cm/s

XT X-Tick

XT;

Purpose: Draws vertical X-tick at current pen location.

YT Y-Tick

YT;

Purpose: Draws horizontal Y-tick at current pen location.

NOP INSTRUCTIONS

In order to maintain software compatibility with the HP 9872 plotter, the HP 7090 recognizes the following HP 9872-related instructions as NOP (no operation) instructions:

- AF* Advance Full Page
- AH* Advance Half Page
- AP* Automatic Pen Pickup
- EC* Enable Cutting Line
- PG* Advance Full Page
- VA* Advance Velocity
- VN* Normal Velocity

DEFAULT COORDINATE VALUES

The following tables show the default plotter unit coordinate values that define the hard- and soft-clip limits and scaling point locations. For rotated coordinates, exchange the X- and Y-values.

Hard-Clip and Default Soft-Clip Limits

Paper Size	Hard-Clip Limits	
	X _{LL} , Y _{LL}	X _{UR} , Y _{UR}
A	-333, -100	10 703, 7 987
B	-475, -333	16 260, 10 703
A4	-322, -100	11 400, 7 785
A3	-525, -322	15 762, 11 400
Paper Size	Soft-Clip Limits	
	X _{LL} , Y _{LL}	X _{UR} , Y _{UR}
A	0, 0	10 370, 7 987
B	0, 0	16 260, 10 370
A4	0, 0	11 078, 7 785
A3	0, 0	15 762, 11 078

Default Scaling Point Locations

Paper Size	Zero and P1	Full Scale and P2
	Z _X , Z _Y (P1 _X , P1 _Y)	FS _X , FS _Y (P2 _X , P2 _Y)
A	160, 447	10 210, 7 682
B	865, 160	16 140, 10 210
A4	514, 348	10 564, 7 583
A3	325, 514	15 600, 10 564

PLOTTER DEFAULT CONDITIONS

The following chart lists the plotter default conditions set by the *DF* instruction.* The *IN* instruction also sets the plotter default conditions, in addition to the recorder default conditions.

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Function	Equivalent Instruction	Condition
Plotting mode	PA;	Absolute (PA)
Relative character direction	DR 1,0;	Horizontal
Line type	LT;	Solid line
Line pattern length	LT;	4% of the diagonal distance between P1 and P2
Input window	IW;	Set according to current size paper
Relative character size	SR;	Width = 0.75% of $P2_X - P1_X$ Height = 1.5% of $P2_Y - P1_Y$
Symbol mode	SM;	Off
Tick length	TL;	$tp = tn = 0.5\%$ of $P2_X - P1_X$ for Y-tick and 0.5% of $P2_Y - P1_Y$ for X-tick
Standard character set	CS 0;	Set 0
Alternate character set	CA 0;	Set 0
Character set selected	SS;	Standard
Character slant	SL 0;	0 degrees
Mask value	IM 223,0,0;	Recognizes all errors, except position overflow
Scaling	SC;	Plotter units
Pen velocity	VS;	75 cm/s (30 in./s)
Label terminator	DT ETX	ETX (ASCII decimal equivalent 3)
Label origin	LO;	Label starts at current pen position.

*The *DF* instruction has no effect on recorder functions, the location of P1 and P2, the current pen and its position, or coordinate system rotation.

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RECORDER DEFAULT CONDITIONS

The following chart lists the recorder default conditions set by the *IN* instruction, which also sets the plotter default conditions listed by the preceding chart.

Function	Equivalent Instruction	Condition
Range	IR;	All channels set to 10.0 V
Offset	SV;	All channels set to 0.0 V
Grid type and Grid divisions	DG;	User-defined grid A/A4 = 25, 18 (X, Y) B/A3 = 38, 25 (X, Y)
Grid quadrants	DG;	Quadrant 1
Total time	TB;	1.0 s
Post-trigger time	TG;	0 s
Pre-trigger time	TG;	0 s
Trigger level	TA;	0.0 V
Trigger width	TA;	0.0 V
Trigger mode	TM;	Manual
Channel selection	RE 9;	Channel 1 vs time
Data output	DO;	Continuous, all channels, ASCII format, no trigger status
Sample delay	SD;	0.1 s

HP-RL/HP-GL ERROR MESSAGES

Displayed Error Number	Meaning
0	No error
1	Instruction not recognized
2	Wrong number of parameters
3	Parameter out-of-range
4	Not used
5	Unknown character set
6	Position overflow
7	Not used
8	Vector move requested while pinch wheels raised; servo inoperative