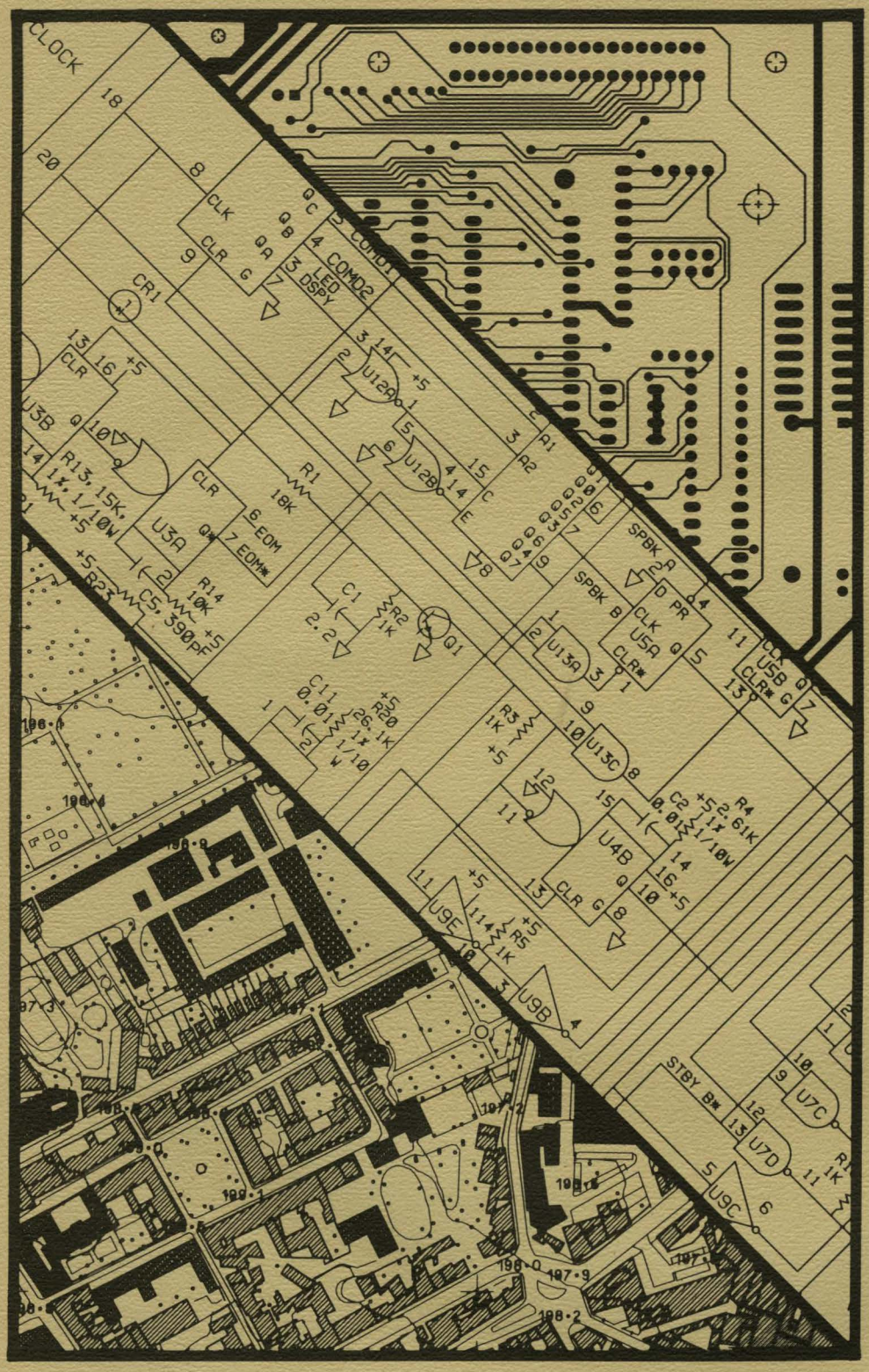

3100

MODEL

SUBSYSTEM SPECIFICATION

PLOTTER CONTROL

MODEL 3100 PLOTTER CONTROL SUBSYSTEM SPECIFICATION

Document Number: 3100-000-SP-000

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CONTENTS (Continued)

SECTION 1
INTRODUCTION

This document describes the Model 3100 Plotter Control.

The Model 3100 Plotter Control provides drafting and photoplotting capabilities in conjunction with a GSI plotter. The control accepts input data from the system terminal, an on-line host computer through either serial or parallel interface options, or off-line from an optional magnetic tape drive. The input data is translated into a series of commands which, when transferred to the plotter, result in the coordinated selection and movement of the drawing tools (pen tip, scribe, light beam) in X and Y axis directions.

The Model 3100 Plotter Control can be used with the following GSI plotters:

Model 32B/C Photoplotter
Model 33B/C Photoplotter
Model 41 Photoplotter
Model 42 SUPERplotter
Model 43 SUPERplotter
Model 75 Plotter
Model 77 Plotter
Model 78 Plotter

SECTION 2
SYSTEM DESCRIPTION

2.1 HARDWARE

The Model 3100 Plotter Control consists of an electronic component module, a hand-held control box, a terminal and keyboard, and cabling to link the control with the input device and plotter. A console to contain the terminal is supplied.

The control comes in a desk top enclosure or mounted in a cabinet if the optional perforated tape reader or magnetic tape drive is ordered.

2.1.1 Model 015 Processor

The Model 3100's CPU is the Model 015 Processor. Memory capacity is 256K bytes. Circuitry allows attachment of four I/O devices in addition to a plotter and serial device.

2.1.2 Model 116 Computer Display Terminal

The Model 116 Computer Display Terminal is provided as the operator's console. This unit has a 12 inch diagonal screen and displays up to twenty-four 80 character lines. The computer display terminal permits manual input and display of system parameters.

2.1.3 Model 373 Floppy Disk Drive

The Model 373 Floppy Disk Drive uses a 5-1/4 inch floppy disk and is used for program loading.

2.1.4 Control Box

The Control Box is a hand-held box containing the switches and indicators described below for operation of the plotter.

Slew (4 switch +X, -X, +Y, -Y). This set of 4 continuous open/closed switches allows the operator to slew the plotter head (or plotter carriages) to any desired position in the drafting area. X and Y switches may be used on-axis only; that is, the plotter may not be slewed in both X and Y axes at once. The plotter may not be slewed outside the plotter drawing limits set after initialization.

Start/Stop. This momentary contact switch starts or stops the plotter. Data stored in the buffers are plotted before a stop occurs.

Halt/Continue. This switch causes an immediate, orderly halt of the plotter, leaving the tool in up position (or photohead shutter closed). The plotter will resume if the switch is pressed a second time.

Error Indicator. This is an indicator only. The operator uses an Error Clear procedure selected from the menu.

2.1.5 Safety Interlock

A safety interlock is provided for use with a GSI supplied safety device. When activated, it brings the plotter to an orderly stop, and lights the HALT indicator. The fault may be cleared and plotting resumed with no loss of input data or plotter position by pressing the Halt/Continue switch on the Control Box.

2.2 SOFTWARE

This section describes the functions of software provided with the Model 3100 Plotter Control.

2.2.1 Data Format

EIA RS-274-D Variable Block Word Address Format is the most commonly used of the three formats available for the Model 3100 Plotter Control. Extended Binary and 500 Format are also available. See Paragraph 3.9 and 3.10 for details. RS-274-D format allows both linear and circular interpolation and optional parabolic and cubic interpolation. It can be used for off-line magnetic tape input, serial (both local and remote) data transmission, and parallel data transmission.

Coordinate Data

Coordinate values (X-, Y-axis) containing up to 10 decimal digits in 0.1 to 5.5 format are accepted and can be incremental or absolute. The Model 3100 permits incremental data with the serial interface; however, absolute data is recommended in this configuration.

Acceptable Codes

EIA Standard RS-358 (ASCII), ISO ASCII, RS-244, BCD, or EBCDIC is accepted in accordance with a subset of EIA Standard RS-274-D. Format range is 0.1 to 5.5 (no integers and one decimal place to five integers and five decimal places with decimal point implied). This implies a best case input data resolution of 0.00001 inch (X55Y55D2M2*, where * = End of Block), in English units. Metric format is from 0.1 to 5.5, a best case resolution of 0.00001 mm.

ASCII Code (EIA RS-358) may be selected as the input data code for magnetic tape input or on-line through serial or parallel lines. EBCDIC code (IBM standard) must be parallel (including magnetic tape).

RS-274-D Magnetic Tape Files

Magnetic tape data files may contain an unlimited number of magnetic tape records. The files are separated by hardware-generated file marks, and the records are separated by hardware-generated inter-record gaps. Records, which must be an even byte length, may be up to 512 words or 1024 bytes. Bytes are packed within the record, with the left byte in the most-significant half of the word, and the right byte in the least-significant half. Records can contain RS-274-D data blocks (logical data blocks which are interpreted into plotter motion) or parameter entries; data such as headers or fillers is illegal. Records need not end on logical RS-274-D data block boundaries; data blocks may continue from one record to another, and start anywhere within a record. Filler characters are not needed and should not be used.

Acceptable Commands

Command explanations for conventional drafting are detailed in the following paragraphs. Codes and commands other than those referred to in these paragraphs generate an error.

Draft function commands are identified by the letter D and up to two integer digits in the range of 00 to 99. Table 2-1 lists acceptable D codes and their explanation.

Table 2-1 **DRAFT FUNCTION COMMANDS**

D Codes

Pen/Shutter Codes:

D01	Pen down/shutter open. The control lowers the pen or opens the photo-head shutter on the current and subsequent motion blocks.*
D02	Pen up/shutter closed. The control will pick the pen up or close the photo-head shutter for the current and subsequent motion blocks.*
D03	Photo Flash. This D Code will draw a Cross Symbol when in pen mode and is effective only for the data block in which it is found.*

Initial Value = D02

*The PEN OVERRIDE function will force the pen into the mode selected. D01-D03 are activated when the PEN OVERRIDE is in AUTO.

Pen/Aperture Select Codes:

D10-D15	In pen mode, these codes select corresponding pens 1-6.
D10-D19	In photo mode, these codes select corresponding apertures 1-10.
D70-D71	In photo mode, these codes select corresponding apertures 11 or 12.
D20-D29	In photo mode, these codes select corresponding apertures 13-22.
D72-D73	In photo mode, these codes select corresponding apertures 23 or 24.

Initial Value = D10

Symbol Set Select Codes:

D10-D99	In photo or pen mode, and preceded by G56, G57 or G58 code, these codes select corresponding symbol from sets 10-99. Supplied set is D10. Sets 10-99 may be user defined.

Dashed Line Select Codes:

D04	Plot a dashed line. Default lengths are dashed = 1/8 inch (3 mm) and space = 1/8 inch (3 mm).
D05	Turn the dashed line feature off.
D06	Plot a dashed line. Default lengths are dashed = 1/4 inch (6 mm) and space = 1/8 inch (3 mm).
D07	Plot a dashed center line. The center line = 1/8 inch (3 mm). Default length are dashed = 1/2 inch (13 mm), space = 1/2 inch (13 mm).

D codes D04, D06, D07 may be user defined through the terminal or in a data stream.

Default Value = D05

Plotting G codes are identified by the letter G and up to two integer digits in the range of 00 to 99. Table 2-2 lists acceptable G codes and their explanation. G codes other than the described below generate linear motion where possible.

Table 2-2 **G FUNCTION COMMANDS**

G codes

Plotting Codes:

G01	The current and subsequent data blocks will use 1.0X linear interpolation.
G02,G20,G21	The current and subsequent data blocks will use clockwise circular interpolation.
G03,G30,G31	The current and subsequent data blocks will use counter-clockwise circular interpolation.
G04	The current data block will be ignored.
G74	Turn off 360-degree circular interpolation. Reverts to G01.
G75	360-degree circular interpolation. Signed I, J, K.

Coordinate Scale Codes:

G10	The current and subsequent data blocks will use 10X scale linear interpolation.
G11	The current and subsequent data blocks will use 0.1X scale linear interpolation.
G12	The current and subsequent data blocks will use 0.01X scale linear interpolation.

Tool Select Codes:

G54	The current data blocks will select tool. (Optional, since D codes may stand alone.)
G55	Flash enabled (in pen mode an X is drawn). (Optional, since D03 will cause a flash with or without G55.)

Symbol Select Codes:

G56	The current data block will draw the symbols from the symbol set labeled with the D Code in the data block.
G57	The current data blocks will list the symbols specified in the data blocks to the list device only.
G58	The current data blocks will plot the symbols and list the symbols to the system list device.

Unit Conversion Codes:

G70	The current and subsequent data blocks will use English units in inches.
G71	The current and subsequent data blocks will use metric units in millimeters.

Default Values are G01, G70, G74, G90.

Coordinate Command Codes:

G90	The absolute mode is activated.
G91	The incremental mode is activated.

Table 2-3 **MISCELLANEOUS FUNCTIONS**

M Codes

Program Stop Codes:

M00	Program Stop. The control stops after execution of this block.
M01	Optional Stop under parameter control. When optional stop is set, an M01 acts as an M00; otherwise it is ignored.
M02	End of Program. The control stops after execution of this block and resets to start condition. No data to follow from input source.
M30	Stop/Rewind. The control stops after execution of this block. If the input device is magnetic tape or perforated tape, the tape is rewound to the beginning. The control is reset to start condition. No data follows from the input source. For input sources other than magnetic tape or perforated tape, an M30 is processed as an M02 (End of Program).

Symbol Scale (SS) Codes:

M50	Plot the specified symbol at scale defined by the following SS parameter in the data stream or as defined in the menu. Defaults to 10x enlargement.
M51	Plot the specified symbol at scale defined by the following SS parameter in the data stream or as defined in the menu. Defaults to 25x enlargement.
M52	Plot the specified symbol at scale defined by the following SS parameter in the data stream or as defined in the menu. Defaults to 50x enlargement.
M53	Plot the specified symbol at scale defined by the following SS parameter in the data stream or as defined in the menu. Defaults to 75x enlargement.
M54	Plot the specified symbol at scale defined by the following SS parameter in the data stream or as defined in the menu. Defaults to 100x enlargement.

NOTE

All symbols are scaled by the coordinate scale factor and the system scale factor, in addition to the symbol scale. Therefore, if the scale factor is 0.5 and the symbol scale is 10, the resultant symbol size will be:

(0.015 by 0.015) x 10 x 0.5 = 0.075 by 0.075

Offset Codes:

M64	Establish current plotter position as new offset and continue plotting.

Other acceptable commands are defined as follows:

W Codes	Format = 3.3 Unit = Degrees Increment = 0.001

Symbol Rotation Codes:

W = -999.999 degrees to +999.999 degrees
A axis = 0 degrees

Positive Rotation calls pivot the symbol around its lower left corner in a counterclockwise direction.

Coordinate Data Codes:

X	X-axis coordinate data.
Y	Y-axis coordinate data.
Z	Z-axis coordinate data.
I	Centerpoint Coordinate. In quadrant circular interpolation (G02,G20,G21,G03,G30,G31) this incremental value is the ABSOLUTE mathematical value along the X-axis between the start of an arc and the arc center. A negative number generates an error. In 360-degree circular (G75), this incremental value is the SIGNED distance along the X-axis between the start of an arc and the arc center. The default condition is positive.
J	Centerpoint Coordinate. In quadrant circular interpolation (G02,G20,G21,G03,G30,G31) this incremental value is the ABSOLUTE mathematical value along the Y-axis between the start of an arc and the arc center. A negative number generates an error. In 360-degree circular (G75), this incremental value is the SIGNED distance between the start of an arc and the arc center along the Y-axis. The default condition is positive.
K	Centerpoint Coordinate. In quadrant circular interpolation (G02,G20,G21,G03,G30,G31) this incremental value is the ABSOLUTE mathematical value along the Z axis between the start of an arc and the arc center. The sign of a K value, if in the data stream, generates an error. In 360-degree circular (G75), this incremental value is the SIGNED distance between the start of an arc and the arc center along the X-axis. The default condition is positive.
EOB	End of Block Character. End of Block is menu selectable. The initial values are: ASCII EOB = Octal 52 (*) EIA EOB = Octal 200 (CR) EBCDIC EOB = Octal 134 (*) ISO ASCII EOB = Octal 12 (LF) Note that other EOB characters are menu-selectable.

Linear Interpolation

Linear interpolation plots a straight line from the present position to the X, Y, or Z coordinate specified by the data block. The preparatory code specifies linear interpolation and a scaling factor. X, Y, and Z commands define the end point.

Circular Interpolation

There are two forms of circular interpolation. The first, quadrant circular, defines a circle as four separate quadrants of data. A circle, which requires a minimum of four data entries, could have an unlimited amount of data entries or data blocks in the data stream. If the circle started off a quadrant axis, in the first quadrant, the entries would be one for the balance of the first quadrant, one for the second quadrant, one for the third quadrant, one for the fourth quadrant, and one for part of the first quadrant that was omitted from the first block.

The second, 360 degree circular interpolation, starts and ends a circle at any point with no regard for the quadrant restrictions. This definition may be represented in the data stream as a single data entry.

Quadrant circular interpolation (G02,G20,G21,G03,G30,G31) defines arcs. It consists of X, Y, and Z commands used to define the end of an arc and I, J, and K commands used to define the arc center in a single block of data; where:

I = the ABSOLUTE distance along the X axis from the arc starting point (current position) to the arc center. Uses the X format. SIGNED values in the data stream generate errors.

J = the ABSOLUTE distance along the Y axis from the arc starting point (current position) to the arc center. Uses the Y format. SIGNED values in the data stream generate errors.

K = the ABSOLUTE distance along the Z axis from the arc starting point (current position) to the arc center. Uses the Z format. SIGNED values in the data stream generate errors.

The I, J, K codes are immediately followed by the absolute values for the dimensions which they represent. When I, J, K codes appear in a block, the X, Y, Z positional information specifies the end of the arc. Start of the arc is described by the current plotter position, and the center point of the arc is described by (I,J,K) data.

360 degree circular interpolation preceded by G75 may define both arcs and circles. It consists of I, J, and K commands, used to define the center of a circle, and X, Y, and Z commands, used to define the end of the arc or circle, where:

I = the SIGNED distance along the X axis from the arc starting point (current position) to the arc center. Uses the X format.

J = the SIGNED distance along the Y axis from the arc starting point (current position) to the arc center. Uses the Y format.

K = the SIGNED distance along the Z axis from the arc starting point (current position) to the arc center. Uses the Z format.

The I, J, and K codes are immediately followed by the arithmetic values for the dimensions which they represent. The X, Y, Z positional information specifies the end of the arc or circle described by the current plotter position (a point), the X, Y, Z point, and the direction and distance provided by the I, J, K data.

2.2.2 Symbol Software

Symbol Feature Operation

A GSI symbol set is provided with each system. This set is designated D10. The operator may define additional symbol sets (D11-D99), or redefine set D10. Figure 2-1 shows the symbol set.

Symbol Definition

Symbols are defined as sets of predefined positional information and codes. Simple symbols include the alphanumeric characters. Symbols are stored in symbol tables, and every symbol in the symbol table has an identifying label by which it can be referenced. The format of the label is:

D##A

D is the D code that specifies symbol display, ## is a number from 10-99 that identifies the symbol set, and A is an alphanumeric character (space, A through Z, zero through 9,/,+,-,., and comma) that identifies each symbol in the set.

There will be a minimum of one active symbol set residing in the system memory. Other sets may be stored. Symbol sets may be loaded into memory by means of the symbol load utility.

For example, D10C identifies symbol C in symbol set 10.

Symbol Calls

The symbol display requires preparatory codes (G codes). The functions of these G codes are:

G56 - Draw symbol identified by next D code.
G57 - Print the symbol on the display.
G58 - Draw the symbol and print it on the display.

Symbols are called by the following:

G56D10THIS IS THE 3100 plots the string "THIS IS THE 3100" in the D10 symbol set.

The spaces in the string are symbol calls which call the space character. The string delimiters (") are not plotted.

Symbol Scale Parameter Effects

Symbols are enclosed in a 0.015 x 0.015 inch or 1.5 x 1.5 mm matrix or "box." This matrix represents the basic symbol size, and provides sufficient margins for proper spacing between symbols. When a symbol scale factor is defined, the entire matrix is scaled rather than the symbol coordinates.

Symbol Rotation

Symbols may be rotated about their 0,0 (lower left) point. To rotate a symbol, a W code is included in the symbol block before the D code. The W code is followed by a + or - number in 3.3 format, which specifies the degree and direction of rotation for the symbol. The degree format is fixed at 3.3 with leading zeros omitted. Symbol sets may be rotated through ± 999.999 degrees.

Symbol Mirror Image

The Symbol Mirror Image parameter is used to invert symbols around one or both axes. The standard mirror parameter has no effect on symbols and is not used while the control is in Symbol Mode.

Terminating Symbol Mode

To terminate symbol mode, any G code except G56, G57, or G58 is entered. The terminating G code precedes all other data in the termination data block. The symbol mode is normally closed out with the entry of a G01, G06, or G07.

Load Symbol Parameter

Symbols may be replaced in symbol sets, added to symbol sets, or symbol sets may be replaced by means of the Load Symbol Utility in the Menu Program or by use of the LS parameter in the data stream. In coding the LS parameter, the following format is required:

LS {0 / 1 / 2} I {0 / 2} *

where: LS0 = replace entire table
LS1 = add to table
LS2 = replace all but standard symbol set

I0 = keyboard
I2 = device specified by the DS parameter

Symbol Data

The data for each symbol consists of:

Symbol label (symbol set number and alphanumeric character)
The data to draw the symbol

Compressed Symbol Data

Compressed symbols use a compressed format where each position within the data block has a defined meaning. Compressed symbols are unaffected by the axis select parameter. They are drawn with an A/X B/Y axis assignment.

Because each compressed symbol definition block is stored in one memory word (16 bits), and the X,Y data uses only 4 bits, the range is limited between 00 and 15. Symbol size is changed through the use of the M codes described in Table 2-3. The compressed symbol format is shown in Table 2-4.

Table 2-4 **COMPRESSED SYMBOL FORMAT**

Character	Meaning	Value	
1st	always 0		
2nd	pen status	0 = pen up	1 = pen down
3rd	linear or circular	0 = linear	1 = circular[1]
4th	circular direction	always clockwise	
5th,6th	number of circular quadrants	00 = 1 quadrants 10 = 3 quadrants	01 = 2 quadrants 11 = 4 quadrants
7th	sign (X or I)	X in linear	I in circular (+ or -)
8th,9th	Value of X or I	X in linear	I in circular (00-15)
10th	sign (X or J)	Y in linear	J in circular (+ or -)
11th,12th	Value of Y or J)	Y in linear	J in circular (00-15)
13th	End of Block	*[2]	*[2]

[1] Must be quadrant circular
[2] Or current EOB character

Figure 2-1 **SYMBOL SET**

2.2.3 System Parameters

Parameters are a set of commands the operator uses in conjunction with plot data to control system operation. Parameters may be defined or altered via menu in the Edit Parameter mode. A subset of parameters is available through menus or data-stream input using ASCII, EBCDIC, BCD, ISO-ASCII, or EIA RS-244 character sets. These parameters require no interaction between the operator and the system.

Parameters in the data stream are preceded and terminated by a parameter flag. The default character is a percent sign (%) in all character sets except EIA where it is a LC (Lower Case) character. Each entry must be terminated by an EOB for the data code in use at the time parameters are entered. Any attempt to change the input code within a data stream creates an error and stops the plotter if the stop on parameter error flag is on. The parameter block must be terminated by another parameter flag. The following parameters are accepted:

Acceleration Limit

Specifies the plotter acceleration rate.

Aperture Offset

Specifies an offset for apertures 2 to 24; Offsets are not entered for aperture 1 because aperture 1 is the reference aperture. Offsets for apertures 2 to 24 are established as fractional distances between the center of aperture 1 and the center of the specified aperture. The offset values must always be fractional.

Aperture Velocity

Specifies a velocity for each aperture, as a percentage of maximum velocity.

Axis Select

Assigns the data representing X, Y or Z to table axis A or B. No data axis may be assigned to more than one table axis.

Block Delete

Turns block delete feature on or off. Blocks containing a slash (/) character are deleted if feature is on.

Dashed Line

Specifies the length of the line and space or line-space-line for the plotting of dashed lines.

End of Block[1]

The end of block character may be altered via menu.

File Search

Selects a magnetic tape file (file numbers 0-9999)[1]

---

[1] Available from the terminal only.

Format Statement

Contains the following information about the data file to be plotted:

Specifies that leading or trailing zeros are to be omitted.
Specifies either absolute or incremental mode.
A sequence number of up to five integers in length may be specified.
The values of X, Y, and Z-Axis input position data may be specified.

Input Code[1]

Defines the code of input data, which may be: ASCII, EBCDIC, BCD, ISO ASCII, EIA RS-244.

Input Data Display

Selects the data to be displayed on the screen. Any or all of the following may be displayed: sequence numbers, G Codes, M Codes, D Codes, I Data, J Data, K Data, W Data, X Data, Y Data, Z Data.

Input Device[1]

Input device may be selected by means of menu edit.

Load Symbol

Loads the desired symbol table.

Mirror Image

Reverses the sign of all values assigned to that axis. Symbol data remains unchanged. Either or both axis may be mirrored.

Mode

Selects millimeters or inches.

Offset

Specifies an offset distance between table zero and the zero position in the Input data. It may be used in absolute mode to indicate the starting point for a plot.

Optional Stop

Enables optional stops in which an M01 functions like an M00.

---

[1] Available from the terminal only.

Scale Factor

Selects a scale factor for the A and/or B axis. The scale factor is positive; a reduction in scale factor is expressed as a decimal fraction.

Sequence Number Start

The control scans the input device until a block containing this sequence number order is found. Plotting begins with this block.

Sequence Number End

Terminates plotting at the block containing this sequence number, but continues to read.

Symbol Mirror

Turns on or off the symbol mirror function for the A and/or B axis. Symbols are mirrored independently of other plot data.

Symbol Scale

Specifies the value of the scale for the symbol sets currently specified by the M Codes 50 - 54 inclusive. Up to five scales may be specified in the same parameter block.

Table Position[1]

Gives actual plotter position, in X or Y axis.

Tape Position[1]

Gives the last coordinate values which were input.

Tool Delay

Allows operator to establish delays.

Velocity Limit

Sets the maximum velocity limit to a percent of the maximum velocity.

2.2.4 Window Feature

The window feature restricts the plotting area to a defined rectangle. There is one firmware window which is the hardware protect window, and one window which is defined and implemented by the operator.

The default window is the hardware protect window. The operator may enter as many or as few limits to the drafting area as are required to define it. The upper bound value may not be less than the corresponding lower bound value.

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[1] Available from the terminal only.

SECTION 3
OPTIONAL HARDWARE AND SOFTWARE

This section describes the optional hardware and software available for the Model 3100 Plotter Control.

3.1 MODEL 104 CONSOLE WITH PRINTER

This device is an interactive terminal with the added versatility of a built-in 120 character/second thermal printer.

3.2 MODEL 223 PERFORATED TAPE READER

This device allows plotting from one inch perforated tape.

3.3 MODEL 328 MAGNETIC TAPE DRIVE

This device is equipped with standard 10.5 inch (267 mm) reels for reading and writing IBM compatible 9 track, 800 and 1600 bpi magnetic tape (switch selectable) at 45 inches/second (114.3 cm/second).

3.4 MODEL 404 SERIES 1 INTERFACE

This device allows the Model 3100 Plotter Control to be interfaced with an IBM Series 1 Host computer.

3.5 MODEL 462 RS-232-C SERIAL COMMUNICATIONS INTERFACE

This option provides the ability to accept data directly from the customer's local (i.e., with 25 cable feet or 7.62 m) or remote (via customer supplied modems) computer system by means of RS-232-C asynchronous interface in customer-specified protocol. The interface hardware conforms to EIA Standard RS-232-C with the customer's system defined as the Data Terminal Equipment (DTE). The interface is configured as the following subset of RS-232-C:

Non-synchronous serial binary data communications.
Standard interface Type D, including CD, Data Terminal Ready.

3.6 MODELS 463 AND 464 PARALLEL INTERFACE

The 16-bit Model 463 and 8-bit Model 464 allow the control to be linked to a host computer, or to a PMS 7000 Plot Management System.

3.7 MODEL 534 PARABOLIC AND CUBIC INTERPOLATION

Parabolic Interpolation allows a parabola to be drawn defined by three data points. Parabolic Interpolation is specified by a G06 code which remains in effect until cancelled by a different G code, in accordance with EIA Standard RS-274-D.

Cubic Interpolation allows a smooth curve to be drawn through four or more data points. Cubic Interpolation is specified by a G07 code which remains in effect until cancelled by a different G code, in accordance with EIA Standard RS-274-D.

3.8 MODEL 538 PLOT QUEUING

Plot Queuing loads a table containing a sequence of up to 16 plots; the plots are thus placed into a queue. The table consists of the queue number, file number, and entered offsets (A and B) for each plot. The utility executes the plots in queue sequence. The queue may be edited.

This software requires the Model 328 Magnetic Tape Drive

3.9 MODEL 539 500 FORMAT

Gerber 500 Format data is packed into blocks consisting of three 16-bit words. Each block contains X, Y, and M data. The coordinate data is incremental only. Sign is specified by the M word.

The resolution of the incoming data is menu selectable allowing, for example, data created for a Model 42 SUPERplotter to be plotted on a Model 32C Photoplotter.

Miscellaneous Control Functions (M Word)

The third word of the block is the Miscellaneous Control Function Word (M Word). It provides bit configurations for all functions which can be executed by the control under 500 Format. Bit designation is supplied in Table 3-5. Bit 0 is the least significant bit (LSB). If a bit does not apply it should be zero.

500 Format Magnetic Tape Files

Magnetic tape data files may contain an unlimited number of magnetic tape records. The files are separated by hardware-generated file marks, and the records are separated by hardware-generated inter-record gaps. Record length is menu selectable (160 or 159 word), with 53 MXY data blocks. The last word of a 160 word record must contain a filler, but no other fillers or data headers are allowed. The last record of a file may be of variable length.

Table 3-1 MISCELLANEOUS CONTROL FUNCTION (M WORD)

SIGN AND TOOL SELECTION BITS

BIT		EXPLANATION	
0	X Axis Sign	0 = Positive	1 = Negative
1	Y Axis Sign	0 = Positive	1 = Negative
2	Tool Up/Down	0 = Up	1 = Down
3	Flash Bit	0 = No Flash	1 = Flash
4	Program Stop	0 = No Stop	1 = Stop
5	Ignored		
6	Ignored		
7	Ignored		
8	Tool Change	0 = No New Tool	1 = New Tool Select
9	Dash Line	Explained in Dash Line Bit Configuration Table	
10	Dash Line		
11	Tool/Aperture Selection	0 = Tools 1 to 12	1 = Tools 13 to 24
12	Tool/Aperture Selection		
13	Tool/Aperture Selection	Explained in Tool Selection Bit Configuration Table	
14	Tool/Aperture Selection		
15	Tool/Aperture Selection		

DASH LINE BIT CONFIGURATION

BIT				MEANING
10	9	3	2	
0	X	0	0	Tool up (dash line off)
X	X	0	1	Tool down (dash line off)
X	X	1	0	Photo flash
0	0	1	1	Dash line type 1 on
0	1	1	1	Dash line type 2 on
1	0	1	1	Dash line type 3 (center line) on
1	1	1	1	Dash line off

TOOL SELECTION BIT CONFIGURATION

BIT				TOOL/APERTURE NUMBER	
15	14	13	12	BIT 11 = 0	BIT 11 = 1
0	0	0	0	1	13
0	0	0	1	2	14
0	0	1	0	3	15
0	0	1	1	4	16
0	1	0	0	5	17
0	1	0	1	6	18
0	1	1	0	7	19
0	1	1	1	8	20
1	0	0	0	9	21
1	0	0	1	10	22
1	0	1	0	11	23
1	0	1	1	12	24

3.10 MODEL 540 EXTENDED BINARY FORMAT

Extended Binary Format is a compact data format which is easy for a computer to prepare. It is primarily intended for use with controls operating on-line to a host computer through the 16-bit parallel interface.

Words are transferred in the following order:

M Word 1
M Word 2, if specified in M Word 1
X Coordinate Word
X Coordinate Word 2, if specified in M Word 1
Y Coordinate Word
Y Coordinate Word 2, if specified in M Word 1

Data Blocks

Data is packed into logical data blocks three, four, or six words long, each word being 16 bits. The length of the block is determined by the type of data it contains. Each record contains M, X, and Y data.

M Data Formats

The first word in each data record is the M1 word. M1 Word functions are listed in Table 3-2. M2 Word functions are listed in Table 3-3.

NOTE: The format of the M words is designed to cover all situations. If a bit does not apply it should be zero. Inclusion of a bit in the data format does not imply that capability for any particular plotter. Capabilities of any given plotter are defined in the plotter specification.

Table 3-2 **EXTENDED BINARY M WORD 1 FUNCTIONS**

M Word 1 Bits	Meaning
15	1 = 2nd M Word follows; 0 = No M Word 2
14	1 = Double Precision Data, (X Word 2 and Y Word 2)
13,12,11	
0, 0, 0	Rapid Traverse
0, 0, 1	Line Draw
0, 1, 0	Photo Flash
0, 1, 1	Line Draw type 2 (used with special photoheads)
1, 0, 0	Not Used
1, 0, 1	Dashed Line Type 1 RS 274-D defaults
1, 1, 0	Dashed Line Type 2
1, 1, 1	Dashed Line Type 3 (Centerline)
10-0	Binary Encoded Tool/Apt Number

Table 3-3 **EXTENDED BINARY M WORD 2 FUNCTIONS**

M Word 2 Bits	Meaning
15-9	Not used (must be zero)
8	0 = X,Y Incremental data, 1 = X,Y Absolute data
7-4	Not used (must be zero)
3	0 = Continue, 1 = Programmed stop (M00)
2	Not used (must be zero)
1	Flush data, 1 = End of job (M02), 0 = Continue
0	0 = Continue, 1 = Set origin to current plotter position and continue M(64)

X, Y Data Formats

The X and Y data follows the M data in every block. X and Y are 32-bit or 16-bit integers depending on bit 14 of M Word 1. Negative numbers are represented by two's complement binary integers. X and Y represent absolute or incremental position depending on bit 8 of M Word 2.

The value of the LSB equals the resolution of the plotter to which the control is interfaced.

Extended Binary Magnetic Tape Files

Extended-binary magnetic-tape data files may contain an unlimited number of magnetic tape data records. The files are separated by hardware-generated file marks, and the records are separated by hardware-generated inter-record gaps. The records may be of variable length, with a maximum size of 512 sixteen-bit words. These records are subdivided into logical data blocks, three, four, or six words long. There may be a variable number of data blocks per record and the records need not end at logical data blocks. In other words, a record may begin in one data block and continue into another. A logical data block consists of MXY data words only; headers and fillers are not allowed.

3.11 MODEL 544 PLOT PREVUE STATION

Plot Prevue allows an operator to view a plot on a Model 149 Graphics Video Display. Pan and Zoom keys permit rapid inspection of plot elements.

Plot Prevue consists of the following:

Model 149 Graphics Video Display

15 inch diagonal monochrome screen; 512 x 512 resolution; 80 column by 20 or 24 line alphanumeric display.

Model 173 Graphics Keyboard

Full ASCII alphanumeric keyboard with graphics cursor control keys.

Hardware Graphics Feature

PAN KEYS:	Two panning modes provide the operator with means to move the window around the displayed plot. Panning is accomplished by using the four arrow keys on the keyboard.
ZOOM KEYS:	Rescales the graphics to display a selected area at greater magnification. The display can be zoomed up to 8x, in 1x increments.
DISPLAY MODE KEY:	Allows instant toggling between the alphanumeric and graphics mode.
SCREEN BLANKING KEY:	Allows screen to be blanked without loss of data. This is useful if the screen is located near a photoplotter and film is being mounted.

Software

Software required to operate Plot Prevue with the Model 3100 is included.

SECTION 4
INSTALLATION CONSIDERATIONS

4.1 PLOTTER COMPATIBILITY

The Model 3100 Plotter Control is compatible with all basic and optional configurations of the following GSI Plotters except as noted below.

Compatible Plotter	Exceptions
32B/C	VAPE, K-Mirror
33B/C	VAPE
41	no exceptions
42/42F	pencil head, tangential cutting head
43/43F	no exceptions
75	OLF, pattern cutter head, pencil head, zero-zero referencing, tangential cutting head
77/77F	pencil head, zero-zero referencing, tangential cutting head
78	pencil head, zero-zero referencing, tangential cutting head

4.2 ENVIRONMENTAL

The control is designed and constructed to operate continuously in a normal office environment, as follows:

Ambient temperatures: 60-80°F (16-26°C)

Relative humidity: 40-60%

4.3 ELECTRICAL

All electrical equipment and its installation on the system conform to the latest practices of the computer industry.

Interconnecting cables between separate enclosures are furnished by GSI and are run in raceways furnished by the Customer. A detailed equipment layout showing recommended raceways is provided by GSI prior to shipment of the equipment.

SYSTEM POWER REQUIREMENTS

Model Number	Power Required*
3132, 3133, 3143	120-208 Vac, 60 Hz, 3-phase, 4-wire wye plus ground, 45 amp.
3141	Two 120 Vac, 60 Hz, 20-amp legs, zero potential neutral and ground or one 120 Vac, 60 Hz, 30-amp legs, zero potential neutral and ground.
3142	Two 120 Vac, 60 Hz, 20-amp legs, zero potential neutral and ground. One 120 Vac, 60 Hz, 30 amp legs with male connector Hubble #2611.
3175	120/208 Vac, 60 Hz, 3-phase, 4-wire wye plus ground, 60 amps per leg.
3178	120/208 Vac, 60 Hz, 3-phase, 4-wire wye plus ground, 40 amps per leg.

Control consumption averages 10 amps.

Input Line Transients: Must not exceed ±500V for 50 microseconds or ±1000V for 100 nanoseconds.

* An uninterruptable safety earth ground connection of no more than 6 ohms resistance must be provided to the system. The voltage differential between neutral and earth ground must not exceed 1 volt when measured at the system power line input terminals. The fluctuation of this value must not exceed 25 millivolts peak to peak.

4.4 WEIGHTS AND MEASURES

	Height (in inches)	Width (in inches)	Depth (in inches)	Weight (in pounds)
Control	9	19	24	40
Control in cabinet	71	24	28	240
Control with tape drive	71	24	28	400
Keyboard	2.6	15	7	2
Display	12.3	14	14.5	20

4.5 CABLING AND CONNECTORS

GSI provides cabling between the host computer, the Model 3100, and the plotter.

The connectors and cables linking the Model 3100 with the host computer depend on the interface mode employed (see Appendices), and the configuration of the host computer.

The serial interface configuration uses a standard (25 pin) RS-232-C connector on the CPU board, and a 50 foot (15.2 m) cable terminated in a Cinch DB-25S or equivalent connector, on both ends.

The parallel interface configuration uses a connector on the parallel card and a cable.

GSI supplies 50 feet (15.2 m) of cable to connect the Model 3100 to the Host. Optional cable lengths to 1000 feet (305 m) are available.

All data and command signals are twisted pairs. Input and output connectors are 3M Type 3417 or equivalent, mass-terminated pocket connectors.

4.6 HEAT DISSIPATION

870 BTU per hour.

MODEL 3100 PLOTTER CONTROL SUBSYSTEM SPECIFICATION

APPENDIX A
INTERFACE SPECIFICATIONS

CONTENTS

Illustrations

Tables

APPENDIX 1
INTRODUCTION

The Model 3100 Plotter Control may be equipped with an interface permitting data transmission from a customer supplied computer or CAD system directly to plotting system without intermediate media (i.e., magnetic or punched tapes).

This interface may be configured for 16-bit parallel, 8-bit parallel, or 8-bit serial (RS-232 asynchronous) applications. All three interface types may be used between the Model 3100 Plotter Control and a local customer supplied CAD or computer system. The serial interface may also be configured for use with a customer supplied modem to interface a remote computer or CAD system via standard voice grade telephone lines.

The 16-bit parallel interface configuration is recommended whenever the Model 3100 includes a high speed plotter (e.g., GSI Models 42, 43, 77 or 78).

All three interface modes discussed herein provide for transfer of plot files from the customer's CAD or computer system to the Model 3100 Plotter Control only. No provision is made for data transfer from the Model 3100 to the customer's CAD or computer system.

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APPENDIX 2
PARALLEL INTERFACES (8- AND 16-BIT)

This appendix describes the interface for local 16-bit parallel communications between a Model 3100 Plotter Control and a customer's computer or CAD system. The customer's computer is considered the host and sends data to the Model 3100 upon request.

Although this interface is referred to as 16-bit parallel, comments here also apply to the 8-bit parallel configuration.

2.1 HARDWARE

The customer's computer is the host and sends data to the Model 3100 via 8 or 16 bit parallel lines. These 16 input and 16 output as well as a input flag and output control are differential twisted pair line drivers and receivers similar to SN75182 and SN75183.

The host computer interface provides 8 or 16 data output lines, and an Input Flag (IFLG) line. The Model 3100 provides a Data Output Control (DOCTRL) line.

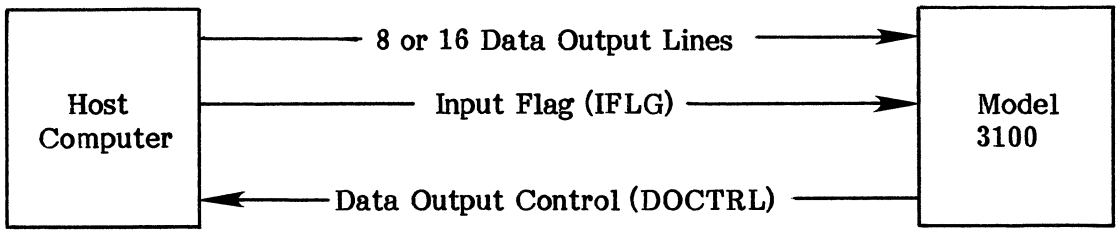

Figure 2-1 **BLOCK DIAGRAM SHOWING COMMUNICATION LINES**

2.2 PROTOCOL

The data output lines remain valid for sampling 500 nanoseconds after the leading edge of IFLG.

The IFLG line notifies the Model 3100 that a data word is available. Data lines must be stabilized prior to IFLG being set.

2.3 DATA TRANSFER SEQUENCE

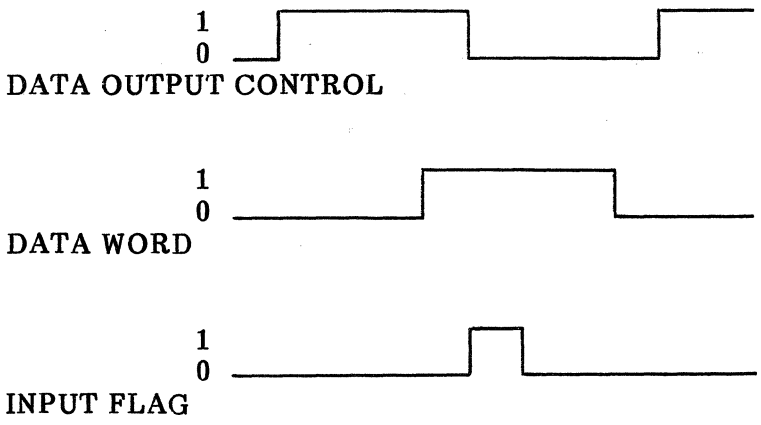

Figure 2-2 **SEQUENCE DIAGRAM**

The host computer must be "cold started" prior to the Model 3100. IFLG should be reset by the host computer.

The Model 3100 sets the DATA OUTPUT CONTROL (DOCTRL) line when the Start button is activated. The DOCTRL line is reset during a stop or power down state.

The host computer outputs a data word and sets the INPUT FLAG (IFLG) signal. The DOCTRL line is reset by the leading edge of IFLG. When the Model 3100 is ready for more data it sets the DOCTRL line again.

2.4 DATA STRUCTURE

For 16-bit parallel applications, the Most Significant Bit (MSB) is bit 15 and Least Significant Bit (LSB) is bit 0. When a character data format is selected, two characters are packed per 16-bit word; the first being defined by bits 15 through 8, the second by bits 7 through 0. Bit 15 then becomes the MSB of the first character and bit 7 the MSB of the second character.

For 8-bit parallel applications, bit 7 is the MSB and bit 0 the LSB. When a character data format is selected, one character is transmitted per 8-bit byte.

Refer to GSI Document 40101-S00-066 (Gerber Format) for definition of data formats and codes.

2.5 PHYSICAL CONNECTION

GSI supplies 100 feet (30.48 m) of cable to connect the Model 3100 to the host. Optional cable lengths to 1000 feet (304.8 m) are available. The cable is terminated in a customer supplied connector or left unterminated.

All data and command signals are twisted pairs. Wire assignments are given in Table 2-1.

Table 2-1 **PARALLEL INTERFACE WIRE ASSIGNMENTS**

Supplied cable connector

Input Signals

$\overline{\text{BITI}\emptyset}$	B34	BRN
$\overline{\text{BITI}\emptyset}$	A34	WHT
$\overline{\text{BITI1}}$	B35	RED
$\overline{\text{BITI1}}$	A35	WHT
$\overline{\text{BITI2}}$	B36	ORG
$\overline{\text{BITI2}}$	A36	WHT
$\overline{\text{BITI3}}$	B37	YEL
$\overline{\text{BITI3}}$	A37	WHT
$\overline{\text{BITI4}}$	B38	GRN
$\overline{\text{BITI4}}$	A38	WHT
$\overline{\text{BITI5}}$	B39	BLU
$\overline{\text{BITI5}}$	A39	WHT
$\overline{\text{BITI6}}$	B40	VIO
$\overline{\text{BITI6}}$	A40	WHT
$\overline{\text{BITI7}}$	B41	GRY
$\overline{\text{BITI7}}$	A41	WHT
$\overline{\text{BITI8}}$	B42	BLK
$\overline{\text{BITI8}}$	A42	WHT
$\overline{\text{BITI9}}$	B43	WHT/BRN
$\overline{\text{BITI9}}$	A43	WHT
$\overline{\text{BITI10}}$	B44	WHT/RED
$\overline{\text{BITI10}}$	A44	WHT
$\overline{\text{BITI11}}$	B45	WHT/ORG
$\overline{\text{BITI11}}$	A45	WHT
$\overline{\text{BITI12}}$	B46	WHT/YEL
$\overline{\text{BITI12}}$	A46	WHT
$\overline{\text{BITI13}}$	B47	WHT/GRN
$\overline{\text{BITI13}}$	A47	WHT
$\overline{\text{BITI14}}$	B48	WHT/BLU
$\overline{\text{BITI14}}$	A48	WHT
$\overline{\text{BITI15}}$	B49	WHT/VIO
$\overline{\text{BITI15}}$	A49	WHT
$\overline{\text{IFLG}}$	B24	WHT/GRY
$\overline{\text{IFLG}}$	A24	WHT
$\overline{\text{DICTRL}}$	B25	WHT/BLK
DICTRL	A25	WHT
CABLE SHIELD GROUNDED AT ONE END ONLY	NC	DRAIN

Table 2-1 **PARALLEL INTERFACE WIRE ASSIGNMENTS**
(Continued)

Supplied cable connector

Output Signals

BITO0	B1	WHT/BLK/BRN
BITO0	A1	WHT
BITO1	B2	WHT/BLK/RED
BITO1	A2	WHT
BITO2	B3	WHT/BLK/ORG
BITO2	A3	WHT
BITO3	B4	WHT/BLK/YEL
BITO3	A4	WHT
BITO4	B5	WHT/BLK/GRN
BITO4	A5	WHT
BITO5	B6	WHT/BLK/BLU
BITO5	A6	WHT
BITO6	B7	WHT/BLK/VIO
BITO6	A7	WHT
BITO7	B8	WHT/BRN/GRY
BITO7	A8	WHT
BITO8	B9	WHT/BRN/RED
BITO8	A9	WHT
BITO9	B10	WHT/BRN/ORG
BITO9	A10	WHT
BIT10	B11	WHT/BRN/YEL
BIT10	A11	WHT
BIT11	B12	WHT/BRN/GRN
BIT11	A12	WHT
BIT12	B13	WHT/BRN/BLU
BIT12	A13	WHT
BIT13	B14	WHT/BRN/VIO
BIT13	A14	WHT
BIT14	B15	WHT/BRN/GRY
BIT14	A15	WHT
BIT15	B16	WHT/RED/ORG
BIT15	A16	WHT
DOCTRL	B22	WHT/RED/YEL
DOCTRL	A22	WHT
OFLG	B33	WHT/RED/GRN
OFLG	A23	WHT
GND	A50	WHT/RED/BLU
GND	B50	WHT
SPARE		WHT/RED/VIO
SPARE		WHT
SPARE		WHT/RED/GRY
SPARE		WHT
SPARE		WHT/YEL/ORG
SPARE		WHT
SPARE		WHT/YEL/GRY
SPARE		WHT

APPENDIX 3
SERIAL INTERFACE

This appendix describes the interface for 8-bit serial asynchronous communications between the Model 3100 and a customer's local or remote computer or CAD system.

The interface hardware conforms to EIA Standard RS-232-C with the customer's system defined as the Data Terminal Equipment (DTE). The Model 3100 interface is configured as the following subset of RS-232-C.

Non-synchronous serial binary data communications.
Non-automatic answers of calls.
Standard interface type D, including circuit CD, DATA TERMINAL READY.

Local or remote interface connections are available for the Model 3100. For local connection, the Model 3100 is defined as the Data Communication Equipment (DCE). The Model 3100 is defined as the Remote Data Terminal Equipment when connected at a remote site.

3.1 LOCAL CONFIGURATION

Circuits implemented in the local communications interface are shown in Figure 3-1.

GSI supplies 50 feet of cable terminated in a Cinch DB-25S connector or equivalent.

3.2 REMOTE CONFIGURATION

Circuits implemented in the remote communications interface are shown in Figure 3-2.

3.3 DATA FORMAT

Data format is user definable for the Model 3100 when that control is interfaced to the customer's computer via either local or remote serial interface. Data character code is even parity ASCII in accordance with EIA RS-358. Although the Model 3100 accepts incremental data it is recommended absolute data be used. Refer to Gerber Format for additional information.

MODEL 3100 PLOTTER CONTROL

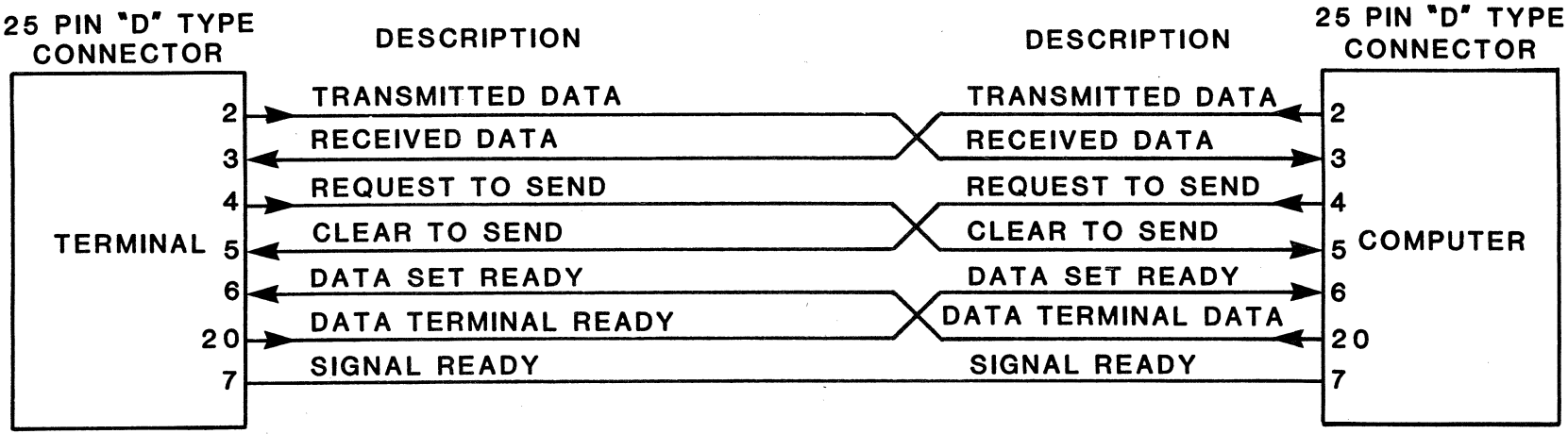

Figure 3-1 **LOGICAL CIRCUITS FOR LOCAL CONNECTION**

MODEL 3100 PLOTTER CONTROL

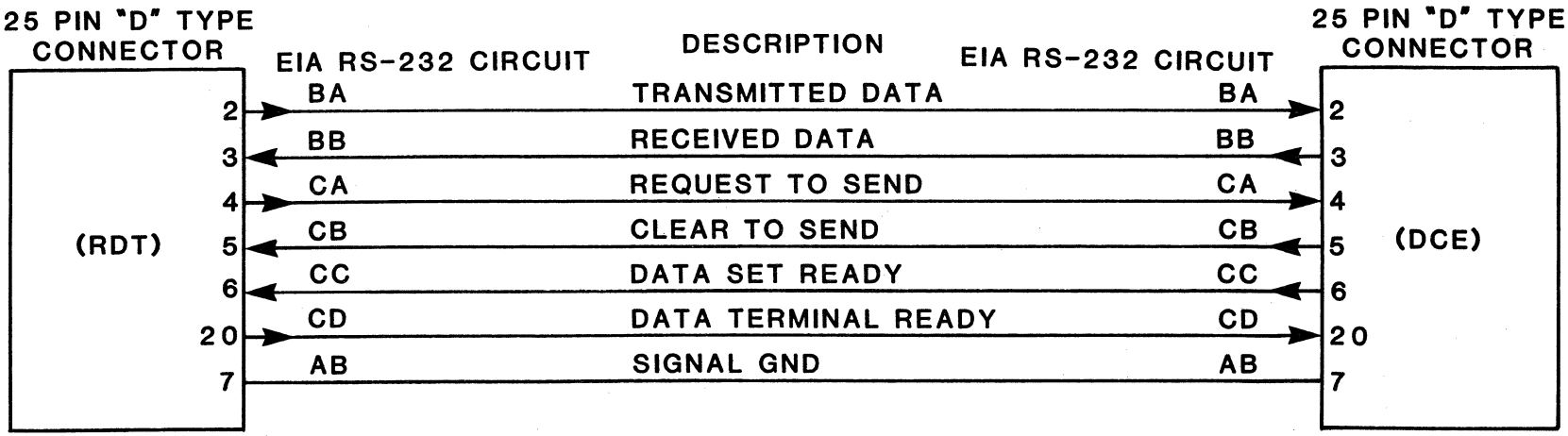

Figure 3-2 **LOGICAL CIRCUITS FOR REMOTE CONNECTION**

Table 3-1 **DATA TRANSFER SEQUENCE (LOCAL FROM HOST)**

Model 3100 Serial Local Data Transfer Sequence from the Host's point of view.

CONTROL (DCE)	HOST (DTE)
	1. Data is prepared and serial driver is invoked.
INITIAL HANDSHAKE SEQUENCE	
2. DSR set.	
	3. DTR set.
	Host enters Transmit mode.
Control enters Receive mode.	
	4. RTS set.
5. CTS set.	
	6. When CTS is set: transmits data (Note 1). or transmits Null (hexadecimal zero) to indicate end of file.
7. Receives data from host. A. If no error prepare ACK (hexadecimal 06). B. If error (Note 2) prepare NAK (hexadecimal 15). C. If Null, proceed to Step 12.	
8. (Transmit mode); CTS reset.	
	9. (Receive mode); RTS reset.
10. When RTS is reset: transmits character prepared in Step 7. Proceed to Step 5.	
	11. Receives character from Control. If ACK, returns to Step 4. If NAK, prepares to retransmit last data sequence, and returns to Step 4.
12. Reset DSR.	

Table 3-2 DATA TRANSFER SEQUENCE (REMOTE FROM HOST)

Model 3100 Serial Remote Data Transfer from the Host's point of view.

CONTROL VIA MODEM (DCE)	HOST (DTE)
	1. Data is prepared and serial driver is invoked.
INITIAL HANDSHAKE SEQUENCE	
2. DSR set.	
	3. DTR set.
	Host enters Transmit mode.
Control enters Receive mode.	
	4. RTS set.
5. CTS set.	
	6. When CTS is set: transmits data (Note 1). or transmits Null (hexadecimal zero) to indicate end of file.
7. Receives data from host. A. If no error prepare ACK (hexadecimal 06). B. If error (Note 2) prepare NAK (hexadecimal 15). C. If Null, proceed to Step 12.	
8. (Transmit mode); CTS reset.	
	9. RTS reset.
10. When RTS is reset: transmits character prepared in Step 7. Proceed to Step 5.	
	11. Receives character from Control. If ACK, returns to Step 4. If NAK, prepares to retransmit last data sequence, and returns to Step 4.
12. Reset DSR.	

Table 3-3 **DATA TRANSFER SEQUENCE (LOCAL FROM CONTROL)**

Model 3100 Serial Local Data Transfer Sequence from the Control's point of view.

CONTROL (DCE)	HOST (DTE)
	1. Invokes Serial driver and waits for handshake sequence to begin. Receives DSR; Pin 6 = H.
2. Serial input data mode and local mode type of connection is selected from menu.	
INITIAL HANDSHAKE SEQUENCE	
3. Issues DTR; DTR = H.	
	4. Issues DTR; Pin 20 = H.
5. Receives DSR; DSR = H (Timeout will occur.)	
	Host enters Transmit mode.
Control enters Receive mode	
	6. Issues RTS; Pin 4 = H.
7. Issues RTS (OFF); RTS = H.	
	8. Receives CTS; Pin 5 = H.
	9. Transmits data to Control. Finish transmission sequence with End of Transmission indicator (Note 1). or Transmits Null (hexadecimal zero); end of file. Proceed to Step 18.
10. Receives data from host.	
A. If current End of Transmission indicator received. (Note 1). Check error status (Note 2). If true (error), prepares to transmit NAK (hexadecimal 15). If false (no error), prepares to transmit ACK (hexadecimal 06).	
B. If end of file (Null), proceed to Step 17.	

Table 3-3 **DATA TRANSFER SEQUENCE (LOCAL FROM CONTROL)**
(Continued)

CONTROL (DCE)	HOST (DTE)
11. (Transmit mode) Issues RTS (ON); RTS = L	
	12. (Receive mode) Receives CTS; Pin 5 = L.
	13. Issues RTS; Pin 4 = L.
14. Receives CTS; CTS = L. (Timeout will occur.)	
15. Transmits character prepared in Step 10. Proceed to Step 7.	
	16. Receives character from Control. If ACK, returns to Step 6. If NAK, prepares to transmit last data sequence, and returns to Step 6.
17. Issues DTR; DTR = L. Control returns to main program with a menu prompt.	
	18. Receives DSR; Pin 6 = L.

Table 3-4 **DATA TRANSFER SEQUENCE (REMOTE FROM THE CONTROL)**

Model 3100 Serial Remote Data Transfer Sequence from the Control's point of view.

CONTROL (RDT)	MODEM (DCE)
	1. Invokes Serial driver and waits for handshake sequence to begin. Receives DSR; Pin 20 = H.
2. Serial input data mode and Remote mode type of connection is selected from menu.	
INITIAL HANDSHAKE SEQUENCE	
3. Issues DTR; DTR = H.	
	4. Issues DTR; Pin 6 = H.
5. Receives DSR; DSR = H (Timeout will occur.)	
	Host enters Transmit mode.
Control enters Receive mode.	
	6. Issues CTS; Pin 5 = L.
7. Issues RTS (OFF); RTS = L.	
	8. Receives RTS; Pin 4 = L.
	9. Transmits data to Control. Finish transmission sequence with End of Transmission indicator (Note 1).
	or
	Transmits Null (hexadecimal zero); end of file. Proceed to Step 18.
10. Receives data from host.	
A. If current End of Transmission indicator received. (Note 1). Check error status (Note 2). If true (error), prepares to transmit NAK (hexadecimal 15). If false (no error), prepares to transmit ACK (hexadecimal 06).	
B. If end of file (Null), proceed to Step 17.	

Table 3-4 **DATA TRANSFER SEQUENCE (REMOTE FROM THE CONTROL)**
(Continued)

CONTROL (RDT)	MODEM (DCE)
11. (Transmit mode) Issues RTS (ON); RTS = H	
	12. (Receive mode). Receives RTS; Pin 4 = H.
	13. Issues CTS; Pin 5 = H.
14. Receives CTS; CTS = H. (Timeout will occur.)	
15. Transmits character prepared in Step 10. Proceed to Step 7.	
	16. Receives character from Control. If ACK, returns to Step 6. If NAK, prepares to transmit last data sequence, and returns to Step 6.
17. Issues DTR; DTR = L. Control returns to main program with a menu prompt.	
	18. Receives DTR; Pin 20 = L.

NOTES

NOTE 1: Two communications modes are available:

Block Mode: A transmit sequence is defined as transmission of a variable-length block of data characters terminated by a user-defined End-of-Block character. Default EOB is an asterisk (*).

Buffered Mode: A transmit sequence is defined as a transmission of a fixed-length buffer of data characters. Buffer size is user-definable. Default size is 1024 characters.

NOTE 2: When the Model 3100 detects an error condition, a fixed number of attempts are made to retransmit the same data (number of retries is user-definable). Three error conditions are possible:

1. Framing error - Stop bit not detected
2. Parity error - Incorrect parity
3. Overrun - Received data characters have been lost

3.4 PROTOCOL SUMMARY

The host is considered the master, and the Model 3100 the slave. It is therefore up to the host to enter Transmit mode after the initial handshake, and up to the Model 3100 enter Receive mode.

The following step-by-step description is directed toward local communication only. It describes the general operation of the protocol sequence from the control's point of view.

STEPS	SUMMARY
1,2,3,4,5	Basic requirements for determining that host and Model 3100 are ready for data transfer.
6	Host tells Model 3100 not to transmit.
7	Model 3100 enters Receive mode and tells host to start transmission.
8	Host has been polling its CTS line; after Step 7 conditions are met, host knows it is clear to transmit.
9	Actual data transmission of data from host to Model 3100.
10	Data received from host and, depending on error status, preparation of ACK or NAK. If stop condition proceed to 17.
11	Model 3100 enters Transmit mode and tells host not to transmit.
12	Host disables any attempt to transmit data.
13	Host enters Receive mode and tells Model 3100 that it is clear to transmit a character.
14	Model 3100 has been polling its CTS line; after Step 13 conditions are met, Control knows it is clear to send acknowledge character.
15	Model 3100 transmits acknowledge character (ACK or NAK).
16	Host receives acknowledge character and prepares to retransmit last sequence or transmit new sequence. Returns to Step 6.
17	Model 3100 reaches a Stop condition and breaks initial handshake link.
18	Host detects Model 3100 is no longer available for communication.

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APPENDIX 4
IBM SERIES 1 INTERFACE

4.1 SERIES 1 HARDWARE

The following required hardware is customer supplied:

Integrated Digital Input/Output Feature #1560
Customer Access Panel Feature #1590
Customer Access Panel Cable Feature #1593

4.2 GSI HARDWARE

The following required hardware is GSI-supplied:

GVM-2 Interface Board
Isolated Receiver-Driver Board (mounted on connector panel)
Power Supply (mounted on connector panel)

4.3 REQUIRED CABLES

GSI supplies an I/O cable, customer-specified, up to 75 feet long.

Cables are terminated on one end with a 160 pin male connector block, AMP Part Number 202799-2. The female contacts are AMP Part Number 66108-1. The Model 3100 end is terminated with male contacts, AMP Part Number 66106.

The cable is #26 AWG, twisted pair with an overall shield.

4.3.1 Cable Option

The cable is normally wired to use Digital Input Group 0 and Digital Output Group 2. If two GSI plotter controls are driven from the same host, the second control may be wired to Digital Input Group 1 and Digital Output Group 3.

4.3.2 Pushbutton Controlled Interrupt

The twisted pair for Data Input Bit 1 (Series 1) are available on a connector panel in the Model 3100. Customers may wire their own pushbutton-controlled interrupt to the Series 1.

4.4 CIRCUITS

4.4.1 Input Circuits

There are 17 input circuits: 16 Data Output lines and a ready line. These lines are compatible with IBM input/output specifications.[1] The least-significant bit is bit 15; the most-significant bit is zero.

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[1]See the IBM Series 1 User's Attachment Manual, Document Number GA 34-0033-3.

4.4.2 Output Circuits

There are three output circuits: the "External Sync"; and Data Input bits zero and 3. These circuits are compatible with IBM input/output specifications. Logic zero is generated from an isolated 5 volt DC power supply.

4.5 RESERVED INTERRUPTS

4.5.1 Series 1 Interrupts

The following interrupt inputs are reserved on the Series 1:

DI Bit 0	New plot (use optional)
DI Bit 1	Pushbutton (use optional)
DI Bit 2	IBM reserved (non-GSI equipment)
DI Bit 3	Data transfer request (use optional)
Ext Sync	Model 3100 ready to receive

4.5.2 Model 3100 Interrupts

The following interrupts are generated by the Model 3100:

DI Bit 15	New plot
DI Bit 12	Data transfer request
Ext Sync	Model 3100 ready to receive

4.6 DATA TRANSFER SEQUENCE

The following describes the data transfer sequence.

1.	Operator	External sync mode is initiated by the Arm External Sync Command.
2.	Plotter Control	Signifies it is ready to start a new plot from the Series 1 by activating an interrupt on DI bit (0 for Series 1; 15 for control) down level, ground true) for about 10 microseconds.
3.		Generates an interrupt on DI bit (3 for Series 1; 12 for control) (down level, ground true) for about 10 microseconds for each data transfer.

Use of the interrupts is optional with particular Series 1 programs. The plotter control generates both interrupts, whether they are used by the Series 1 program or not.

4.		Wait additional 10 microseconds after generating both interrupts.
5.		Signifies it is ready to receive data from the DO group by activating external sync (down level).

6.	Series 1	Signifies the data is ready by activating the "Ready" output (down level).
7.	Plotter Control	Deactivates the external sync input line (up level; +5 volts) when new data is received.
8.		Repeats sequence starting with Step 3 when ready for another data transfer.

If the STOP button on the plotter control is pressed or if a stop code in a data transfer is encountered, the sequence stops.

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