

HEWLETT  PACKARD

# 9815A/S Desktop Computer

TECHNICAL DATA DECEMBER 1977



## 9815A/S Desktop Computer



The HP 9815 is a desktop computer well suited to a variety of scientific, engineering, research, and industrial applications. Interfacing to Hewlett-Packard plotters, printers, paper tape punches and paper tape readers is easy with an optional interface card. Flexible interfacing is also available for a variety of other instruments with BCD, 8-Bit Parallel, RS-232-C and HP-IB (IEEE 488-1975) interfaces.

The 9815 has built-in mathematical and trigonometric functions, high-speed bidirectional cartridge tape system and alphanumeric thermal printer. The keyboard includes 15 Special Function keys, a 10-key numeric pad, program language and control keys, editing keys and 23 scientific function keys. Data may be entered into the 9815 either through the keyboard or through the 9800 Series input peripherals.

Two basic configurations of the 9815 are available. The 9815S is the most powerful. It includes 3800 program steps and two I/O slots. The standard 9815A includes 472 program steps with options for extending memory to 2008 program steps and for adding two I/O channels.

## General Features

- High speed tape system
- 16-character thermal printer
- 15 Special Function keys
- Auto start
- Flexible program editing

## 9815A Features

- 472 program steps, 10 data registers
- Memory expandable to 2008 program steps (Option 001)
- Two I/O channels (Option 002)

## 9815S Features

- 3800 program steps, 10 data registers
- Two I/O channels

## Specifications

## STORAGE

Dynamic Range:

 $10^{99}$  to  $10^{-99}$ , 0,  $-10^{-99}$  to  $-10^{99}$ 

9815A

R/W Memory: 472 program steps,  
10 data registers

Opt. 001: 2008 total program steps,  
10 data registers

9815S

R/W Memory: 3800 program steps,  
10 data registers

(Memory may be allocated by user into different combinations of program steps and data registers.)

## TAPE CARTRIDGE

Memory Capacity: 96 384 bytes

(8 steps=1 register, 1 step=one

8-bit byte), 12 048 registers

Search speed (bidirectional):

1 524 mm/sec (60 in./sec)

R/W speed: 254 mm/sec (10 in./sec)

Tape length: 42.67 m (140 ft)

File size: 80 bytes to 2 008 bytes,  
programmable

Dimensions: 63.5 x 82.5 x 12.7 mm  
(2.5 x 3.25 x 0.5 in.)

Tape cartridges are intended for nominal program or data storage; the typical life cycle is 50-100 hours of use, depending on the application. Environmental conditions of 25°C (77°F) and 20 to 50% relative humidity are most favorable for long tape life. Tape life is decreased by a high-duty cycle (percent of time the tape is accessed during the total time the 9815 is in use), and continuous use for long periods of time (more than one-half hour). It is suggested that tape transports be regularly cleaned and cartridges removed from drives after use.

## THERMAL PRINTER

Paper: 55mm (2.25 in.) wide,

76.2m (250 ft) long

Print: 5x7 dot matrix, 16-character line

No. of digits: 10 digits maximum, plus sign and signed 2-digit exponent; print format user selectable.

## DISPLAY

Type: 7-segment gas discharge

Size: 16 numeric characters; 10 digits maximum with a signed 2-digit exponent

Notation: Fixed, scientific, scientific 3

Available alpha:

ABCDEFGHIJKLMNOPQRSTUVWXYZ  
0123456789      00AAEE0NE  
( ) , : ; + - \* / = % # ? \$ @ ' & % ÷ ÷ ÷ ÷ < >

## MATHEMATICAL FUNCTIONS

**Built-in:** SIN, COS, TAN,  $e^x$ ,  $\ln$ ,  $\log_{10}x$ ,  $1/x$ , ASIN, ACOS, ATAN,  $10^x$ ,  $y^x$ ,  $\sqrt{x}$ ,  $\Sigma \pm$ , ACC  $\pm$ ,  $x$ ,  $\sigma$ ,  $P \rightarrow R$ ,  $R \rightarrow P$ , INT,  $\rightarrow D$ .MS, D.MS $\rightarrow$ , ROUND X

## ARITHMETIC

Configuration: 4-register stack

Operations:

change sign Enter Exponent

Clear x Clear Stack

Roll Stack Up

Roll Stack Down

Exchange x and y

Shift Stack Up

## ENVIRONMENTAL RANGE

Temperature . . . 5°C to 40°C ambient

Humidity . . . . . 80%

## SIZE/WEIGHT

Height . . . . . 101.6 mm (4 in.)

Width . . . . . 345.4 mm (13.6 in.)

Depth . . . . . 342.9 mm (13.5 in.)

Weight:

Net . . . . . 5.9 kg (13 lb)

Shipping . . . . . 11.8 kg (26 lb)

## POWER REQUIREMENTS

Source . . . . . 100 V +5%, -10%

(switch . . . . . 120 V +5%, -10%

selectable) . . . . . 200 V +5%, -10%

. . . . . 240 V +5%, -10%

Frequency . . . . . 48 to 66 Hz

Consumption . . . . . 100 V/850 mA

120 V/725 mA

220 V/400 mA

240 V/350 mA

## Programming Language

**Programmable Functions:** All operations except editing

**Branching:** Symbolic, absolute or calculated addresses; 100 numeric labels, 15 alpha labels (symbolic); 3 FOR-NEXT loops

**Conditional Operators:**  $x = y$ ,  $x < y$ ,  $x \geq y$  (comparison),  $x = 0$ ,  $x$  positive,  $x$  negative (test  $x$  registers); if flag set, if flag clear (test flags)

**Flags:** 8 flags set, cleared, tested; includes data entry, error detection, and error override; change flag without stopping program execution

**Editing:** Step, back step, insert steps, delete steps; automatic address updating; selective listing of programs or parts of programs

**Subroutines:** Called via symbolic, absolute or calculated addresses; nested to 7 deep

**Special Function Keys:** User definable for program execution; 15 available

**Error Indication:** Descriptive error messages printed immediately after error; programmable error override to continue program execution

**Operating Modes:** RUN — manual operation and program execution. PGRM — writing and editing programs. AUTO START — automatic tape rewind, load file 0, execute program when power is switched on.



# 9815 Interfaces



Hewlett-Packard offers the following interface cards with the HP 9815 Desktop Computer to meet a variety of interfacing requirements:

## Peripheral Interfaces

- 9872A Plotter (98130A)
- 9871A Printer (98131A)
- 9862A Plotter (98132A)

## General Purpose Interfaces

- BCD (98133A)
- 8-Bit Parallel I/O (98134A)
- HP-IB (98135A)
- RS-232-C (98136A)

## Physical Specifications

### POWER

Supplied by the 9815

### WEIGHT

98130A, 98131A, 98132A and 98134A: 1.04 kg (2.3 lb) net  
1.35 kg (3 lb) shipping  
98133A: 1.35 kg (3 lb) net  
1.80 kg (4 lb) shipping  
98135A: 0.9 kg (2 lb) net  
1.35 kg (3 lb) shipping  
98136A: 0.68 kg (1.5 lb) net  
1.0 kg (2.25 lb) shipping

## 9872A Plotter

The 98130A contains both the hardware and 4k words of graphics language needed to interface the 9815 to the 9872 Plotter for multi-color plotting, labeling and digitizing.

The 9815 controls plotter operations via key-sequence instructions which can be executed from either the keyboard or a program.

Because the 98130A is not HP-IB compatible, no select code adjustments are required.

### COMMANDS

SETP — Sets (P1 and P2) lower left and upper right.  
LIMIT — Sets window plotting limits.  
LINE — Sets the line type and pattern length; negative type value sets solid line.  
CHAR — Selects two of the available character sets.  
SPEEDX — Limits the maximum speed in cm/s to the selected pen.  
INPUT — Inputs the current coordinates of the pen in user units.  
SYMB — Indicates decimal equivalent of ASCII character for symbol mode plotting.  
TICS — Sets values for axis tick lengths as percentages of P1 and P2 only.  
AUTOL — Sets the tick labeling frequency and direction on each axis.  
LOG — Indicates one or both axes to be in log base 10.  
MODE — Sets labeling character size and angle to be cm or percent of P1 and P2).  
AVEL — Sets pen speed to automatically track the input data rate.  
APEN — Raises pen if no pen movement occurs within approximately 65 s.  
INIT — Reinitializes the system to its power-on state.  
LABEL — Prints the character string in the alpha mode.  
PLOTA — Moves the pen to coordinates given.  
PENUP — Unconditionally raises the pen.  
PLOT — Moves the pen the incremental values given.  
MOVE — Raises the pen, moves to the coordinates given.

DGTZR — Inputs the 'entered' coordinates in user units.  
SCALE — Assigns user unit values to the area defined by (P1 and P2) of lower left and upper right.  
XAXIS — Draws solid line X-axis; output characteristics subject to some previous input instructions.  
YAXIS — Draws solid line Y-axis; same conditions apply as in XAXIS.  
CSIZE — Sets character height and width.  
ANGLE — Sets lettering direction.  
PRINTX — Prints the value in the X register per the machine format and the field width parameter.  
CPOSI — Moves the pen position the indicated character lines and spaces with the pen raised.  
PENSL — Selects the indicated pen.  
SLANT — Sets character slant angle.  
FUNCT — Precedes additional key entry to produce the secondary set.

### OPTION

This interface requires the two-channel I/O, Opt. 002, on the 9815. It is shipped with a 2.4-m (8-ft) long cable.

## 9871A Printer

This interface permits the 9815 to control the 9871A Character Impact Printer for single- or multiple-copy printing and plotting.

### COMMANDS

CSPC — Sets characters/inch (cm), lines/inch (cm) and view advance on or off.  
PAPER — Sets form and text length, top of form and left margin.  
TABS — Sets up to four horizontal tabs at a time.  
FIELD — Sets the data field width for printing number values.  
PRINT — Outputs the value in X and a CR/LF.  
PRNTX — Outputs the value in X without a CR/LF.



PRNT $\alpha$  — Sets the print alpha mode.  
 PSIZE — Sets the position and physical size of the plot area.  
 SCALE — Sets the scale of the plot area.  
 XAXIS — Draws an x axis.  
 YAXIS — Draws a y axis.  
 CHAR — Specifies the characters to be used for plotting.  
 HLOT — Plots x- and y-coordinate values.  
 IPLOT — Plots incremental values.  
 MOVE — Positions the carrier and platen at a specified point.  
 WBYTE — Outputs individual character codes to the printer.

#### OPTION

The 9815 must be equipped with Opt. 002 if the 98131 Interface is to be used.

### 9862A Plotter

With this interface the 9862 Plotter can be connected to the 9815 Desktop Computer for plotting, lettering and digitizing capability.

#### COMMANDS

SCALE — Sets the scaled size of the plot area.  
 XAXIS — Draws an x-axis.  
 YAXIS — Draws a y-axis.  
 PEN $\uparrow$  — Raises the pen.  
 PLOT — Plots x, y coordinate values.  
 DRAW-6c — Draws a "+" at the current pen position.  
 IPLOT — Plots incremental values from the current pen position.  
 MOVE — Relocates the pen to a specified point.  
 CSIZE — Sets the character size and direction for lettering.  
 PRNTX — Letters the current value in X.  
 PLOT — Sets an alpha mode for lettering.  
 DGTZR — Sets the digitizer mode.  
 EXIT — Enters the current pen coordinates into X and Y.

#### OPTION

The 98132 Interface, shipped with a 2.4-m (8-ft) long cable, will connect to the 9815 only if Opt. 002 is specified.

### BCD

This interface provides the 9815 with both the hardware and internal ROM necessary to input data from a wide variety of bit-parallel, digit-parallel BCD devices. Up to nine BCD digits, in addition to overload and sign information, can be input at data rates extending to 2 000 readings/second. Flexible data formatting allows two devices to be connected to one interface and also provides register packing of input data for efficient memory usage.

The 98133 has an 8-bit parallel output data bus for control of external circuits or devices. Complete control of interface handshake and logic sense of data are implemented via software commands and interface wiring.

The 98133 Interface is shipped with a 4.5-m (15-ft) open-ended cable; there are no options available.

#### SPECIFICATIONS

##### Data Input

The 40 data input lines are entered into CMOS shift registers (CD4034, CD4014) with 10 k $\Omega$  resistors to +5V.

##### Data Output

Eight data output lines are high-voltage (30 V max), open-collector TTL inverters (SN7406).

##### Control Lines

Two interface control lines are high-voltage (15 V max), open-collector TTL, NAND gates (SN7406) - one for data input and one for data output.

##### Flag

Two interface flag lines (TTL Schmitt triggers, SN74LS14) are provided — one for input data, one for output data. Each is operated by its respective peripheral to indicate completion of a data transfer.

##### I/O Direction

Indicates to the peripheral the direction of the current I/O transfer; valid when CTL is valid.

##### Data Formats

Input formats allow specification of the number of BCD digits (with optional exponent) for one or two devices. Up to nine input digits are allowed, and these can be split between two samples. All formats allow overload and illegal character checking. Input data can be examined by the user before being formatted, if necessary. Data is accepted in either positive-true or negative-true formats.

### Data Codes

8421 binary coded decimal weighting; codes 0-9 represent digits 0-9. Other codes are as follows:

1010	} ignored unless flagged
1011	
1100	
1101	
1110	} decimal points
1111	

#### 8-Bit Parallel Input

Eight of the 40 data input lines may be used for burst read input.

#### I/O Speeds

The 98133 interface has three high-speed data modes:

PACK — operates at 1 000 readings/s,

BURST — operates at 2 000 readings/s,

8-BIT INPUT/OUTPUT — operates at 5k bytes/s.

#### COMMANDS

The following commands are implemented as software commands.

WRT — Sends ASCII character strings to an external device.

READ — Inputs the current BCD data.

SAMPL — Returns a single sample from a previous BURST command.

BURST — Inputs a specified number of readings at high speed (unformatted data).

DCODE — Formats the data returned by the BURST command.

INPUT — Performs 8-bit parallel input at high speed.

START — Initiates a BCD data input, then returns to user program immediately.

STAT — Returns the status of the BCD input data (used with START).

PACK — Performs high-speed BCD input with data (packing two or four readings per data register).

UNPAK — Returns the readings from a data register to the user stack from the PACK command.

OUTPT — Performs high-speed 8-bit parallel output.

HNDSK — Sets logic sense of CTL and FLG lines; provides for pulsed mode of CTL operation (30 $\mu$ s pulse).

FRMT — Selects the input data format for incoming BCD data.

MASK — Sets auto checking for overload and illegal characters.

BYTE — Returns the decimal equivalent of any data byte in a 9815 data register.

WBYTE — Sends the binary equivalent of the 9815 X-register to the eight data output lines.

## 8-Bit Parallel I/O

This general I/O interface provides the 9815 with both the hardware and internal ROM necessary to communicate with a wide variety of 8-bit parallel I/O devices. A latched, 8-bit input bus and a latched, 8-bit output bus allow bidirectional transfer of information with typical read/write data rates of 800 bytes/second.

The 98134 is capable of reading and writing numbers in both ASCII and binary formats. Output field specifications for ASCII transfers and Boolean operations for binary data are also provided.

Other instructions include sending and receiving programs, and complete control of I/O handshake, including a peripheral mode of operation for communication with other computers.

This interface is shipped with a 7.6-m (25-ft) open-ended cable.

### SPECIFICATIONS

#### Logic Configuration

Complete control of the logic sense of I/O data and I/O flag is provided via software commands.

#### Data Input

Eight data input lines with 1 k $\Omega$  to +5 V and 1.5 k $\Omega$  to ground terminations accept TTL logic levels.

#### Data Output

Eight data output lines with high-voltage, open-collector TTL drivers (SN7406).

#### Control (CTL)

Indicates to the peripheral that data is ready for output or that the calculator is ready for input; CTL is reset by a ready-to-busy transition on FLG.

#### Flag (FLG)

Driven by the I/O device to indicate completion of a data transfer; logic sense and mode of handshake are controlled by software commands.

#### I/O Direction (I/O)

Indicates to the peripheral the direction of the current I/O transfer, valid when CTL is valid.

#### Stop (STP)

STP is pulsed low (10 ms) when the calculator STOP key is pressed during an I/O transfer.

#### Stop (STP)

STP is pulsed high (10 ms) when the calculator STOP key is pressed during an I/O transfer.

#### Select Code Setting

One of two select codes may be chosen via an internal jumper.

## COMMANDS

The 98134 provides the following software commands:

WRT — ASCII string output

WRTX — ASCII numeric output; uses 9815 data formats.

READX — ASCII numeric input, free-field format, user-definable delimiters.

WRITE — Same as WRTX except a CR/LF is also sent after the number.

FIELD — Field width specifications for WRTX and WRITE.

DELIM — Used to establish delimiting characters between numbers on the READX instruction.

WBYTE — 8-bit binary output; decimal-equivalent numbers from 0 to 255.

RBYTE — 8-bit binary input; decimal-equivalent numbers from 0 to 255.

AND — Logic "AND" of two values in the range 0 to 255.

OR — Logic "OR" of two values in the range 0 to 255.

ROT — Right rotate of an 8-bit number.

LIST — Column-formatted ASCII program listing.

LDPGM — Binary input of 9815 program.

DUPGM — Binary output of 9815 program.

FLAG — Control of the logic sense and handshake modes of 98134 flag line.

DATA — Logic sense control of I/O data.

### OPTIONS AND ACCESSORIES

Connections to the following HP peripherals may be made by ordering one of the options listed here. The 98134 will then be shipped with a 2.4-m (8 ft) cable terminated with the appropriate connector for that peripheral.

Opt. 066 ..... 9866B Thermal Line Printer

Opt. 083 ..... 9883A Tape Reader

Opt. 084 ..... 9884A Tape Punch

## HP-IB

This interface allows the 9815 to communicate via the Hewlett-Packard Interface Bus (HP-IB) to a wide variety of peripheral devices. Up to 14 devices may be connected to the interface with standard HP-IB interface cables.

The 98135 allows the 9815 to operate in a variety of modes, including system controller. Software commands provided with the interface allow a great deal of flexibility in both I/O and data manipulation. Data rates extend to 2 500 bytes/second. Only one 98135 may be used with the 9815.

The 98135A Interface is shipped with a 0.75-m (2.5-ft) interface cable terminated by a metric connector.

### SPECIFICATIONS

The following specifications are in accordance with IEEE Standard Digital Interface for Programmable Instrumentation (IEEE Std. 488-1975).

#### Data I/O

Eight bidirectional data lines.

#### Control Lines

DAV } provide handshake signals  
NRFD } for command and data  
NDAC } transfers

#### Interface Management

IFC } provide control of  
ATN } the interface system  
SRQ }  
REN }  
EOI }

#### Interface Functions

SH1 ..... source handshake  
AH1 ..... acceptor handshake  
T6 ..... talker  
L4 ..... listener  
SR1 ..... service request  
RL0 ..... remote local  
                    (no capability)  
PP0 ..... parallel poll  
                    (no capability)  
DC1 ..... device clear  
DT0 ..... device trigger  
                    (no capability)  
C1,2,3,4,7 ..... controller

The 98135 has no interrupt capability. Jumpers are provided to select the talk/listen address pair and the system controller function.

## COMMANDS

The 98135 provides the following software commands.

CMD — Sends HP-IB commands and data.

OUTPT — Sends binary data from 9815 data registers.

**WBYTE** — Sends single byte of data to bus or data registers.

WRTX — Sends ASCII numerics to bus or data registers.

STR→ $\infty$  — Transfers binary string from data to program area.

DUPGM — Sends user program to external device.

INPUT — Receives binary string into data registers.

**RBYTE** — Inputs a single byte of data from bus or data registers.

READX — Inputs an ASCII numeric from bus or data registers.

$\alpha \rightarrow \text{STR}$  — Transfers a string from program to data storage.

LDPGM — Inputs a user program.

SERPL — Conducts a serial poll.

FIELD — Sets field specification for ASCII numeric output.

**AND** — Performs logic “AND” operation.

OR — Performs logic “OR” operation.

STAT — Returns interface status (2 bytes).

## RS-232-C

This interface, which conforms to the EIA Standard RS-232-C, provides the 9815 with both the hardware and the internal ROM necessary to communicate with a variety of bit serial I/O devices.

Information can be sent as 5-, 6-, 7-, or 8-digit data codes with or without parity and with either 1, 1½ or 2 stop bits. The asynchronous transfer of information can be accomplished at 110, 150, 200, 300, 500, 1200, 1800, 2400 or 3600 baud. Data formats, parity and transfer rates are set conveniently by switch settings on the interface cards.

The 98136 is capable of reading and writing data in both ASCII and binary formats. Output field specifications for ASCII transfers and Boolean operations for binary data are also provided. Other instructions include sending and receiving programs and external listing of 9815 programs.

This interface cable is 0.75-m (2.5 ft) long, terminated by a metric connector.

## SPECIFICATIONS

Pin	Function	Voltage Level
2	Interface data input	
3	Interface data output	±10V
4	Peripheral busy	
5	Interface busy	±10V
6	Interface power on	±10V
7	Signal ground	GND

### Select Code Setting

One of two select codes (2 or 3) may be chosen via an internal jumper. Factory select code is set at 2.

## COMMANDS

The following commands are implemented as software commands.

WRT — ASCII string output.

WRT X — ASCII numeric output, uses 9815 data formats.

READ X — ASCII numeric input, free-field format, user-definable delimiters.

WRITE — Same as WRT X except a CR/LF is also sent after the number.

FIELD — Field width specifications for WRT X and WRITE

DELIM — Used to establish delimiting characters between numbers on the READ X instruction.

WBYTE — 8-bit binary output; decimal equivalent numbers from 0 to 255.

AND — Logic “AND” of two values in the range of 0 to 255.

OR — Logic “OR” of two values

ROT — Right rotate of an 8-bit number in the range of 0 to 255.

LIST — Column-formatted ASCII  
program listing.

LDPGM — Binary input of 9815 program.

DUPGM — Binary output of 9815 program.

**FLAG** — Control of internal handshake of the 98136 hardware (set correctly from factory, no change is recommended).

**DATA** — Logic sense control of I/O data (must be set by user for “positive” true data only).

## OPTIONS

The following options are available for the 98136:

Opt. 001 ... 20 mA current loop;  
receive only

Opt. 002 ... 60 mA current loop;  
receive only



# Ordering Information

## 9815A Options

Item HP Part No.  
2 008 total program steps .. Opt. 001  
2 I/O channels ..... Opt. 002  
3 additional data  
cartridges ..... Opt. 003

## Accessories Supplied

Item HP Part No.  
Guide to the 9815A .. 09815-90001  
Operating & Programming  
Manual ..... 09815-90000  
9815S Operating Note 09815-90013  
Reference card ..... 09815-90010  
Programming forms ... 09815-90011  
General utilities & test  
routines ..... 09815-10000  
Blank data cartridge ..... 9162-0061  
Thermal print paper (three rolls)\*  
Spare fuses  
1.5A ..... 2110-0043  
0.75A ..... 2110-0033  
Dust cover ..... 9222-0490  
Tape head cleaner ..... 8500-1251  
Power cord: depends on origin of order  
\*When ordering paper specify six-roll  
packs, HP part number 9270-0479.

## Interfaces

Item HP Part No.  
BCD Interface ..... 98133A  
General 8-Bit Parallel  
Interface ..... 98134A  
HP-IB (IEEE Std.  
488-1975) ..... 98135A  
RS-232-C Serial Interface .. 98136A  
Tape duplication interface . 98137A

## Accessories Available

Item HP Part No.  
Vinyl carrying case ..... 98145A  
Thermal printer paper .... 9270-0479  
Blank data cartridge ..... 9162-0061  
Blank key overlays ..... 7120-4691

## 9815A/S Peripherals

Description	To purchase the peripheral, order peripheral number:	If peripheral is owned, order card number:
Plotter	9862A, Opt. 015	98132A
Digitizer	9864A, Opt. 015	98134A, Opt. 064
Thermal Line Printer	9866B, Opt. 015	98134A, Opt. 066
Character Impact Printer	9871A, Opt. 015	98131A
Plotter	9872A, Opt. 015	98130A
High Speed Paper Tape Reader	9883A, Opt. 015	98134A, Opt. 083
Paper Tape Punch	9884A, Opt. 015	98134A, Opt. 084

## Purchase Plans

Contact one of the Hewlett-Packard worldwide sales and service offices for specific prices and plans in your area.

Data subject to change.

## Maintenance Agreements

Maintenance agreements are available for all desktop computer products. Current U.S. rates are found in the Maintenance Service and Prices microfiche, No. 5952-2432D. These agreements represent HP's best level of support. Major advantages to the customer include:

- fixed annual cost,
- priority service response,
- on-site service,
- regular maintenance,
- individualized contracts.



For assistance call: Washington (301) 948-6370, Chicago (312) 255-9800, Atlanta (404) 955-1500, Los Angeles (213) 877-1282.

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