Data Pattern Generator

▶ DG2040 • DG2030 • DG2020A

▶ *DG2000 Series.*

The DG2000 Series of pattern generators provide digital designers with the high performance tools needed to evaluate advanced digital semiconductors and logic circuits. Whatever you call your design process – characterization, debug, validation or verification – as a digital designer you must have a state-of-the-art digital pattern generation as you push the edge of the technology envelope and race to market.

Choose the Best Fit

The DG2000 Series is remarkable for its balanced approach to providing the appropriate class of instrument for a wide variety of digital design applications. Performance ranges from 1.1 Gb/s to 200 Mb/s and from 2 to 36 channels. The table illustrates the principal specifications for members of the DG2000 Series.

▶ Features & Benefits

Data Rate to 1.1 Gb/s Tests High-speed Logic Devices and Circuits

Data Pattern Depth to 256 K/Channel Speeds Characterization

Multiple Output Channels Increases Flexibility
– DG2040: 2
– DG2030: 4 or 8
– DG2020A: 12, 24, or 36

Control of Edge Timing (DG2040) Permits Jitter Simulation in Serial Data Streams

Precise Control of Output Parameters Include:
– Variable Output Delay
– Variable Output Level
– Variable Rise and Fall Time Control (DG2030)
– Tri-state Output Control (DG2020A, DG2030)

Fast Transition Times to 150 ps (DG2040) Aids Fast Logic Evaluation

Complementary Output (DG2040) Assures Excellent Signal Fidelity

Flexible Sequence Control with Jump, Event and Nested Loops

Import Pattern Data with DG-link Software Utility

▶ Applications

Ultra Low Jitter for Clock Substitution

Characterize Device Timing for TTL, CMOS, ECL Families

Simulate Missing Functions in System or Subsystem Evaluation

Create Complex Data Patterns with Sophisticated Sequence, Looping, Jump on Event and Tri-state Output Control

Characterize and Verify ASIC, FPGA and DACs

Test Printer Engines or LCD Display Drivers

Use in Conjunction with TLA Logic Analyzer to Provide Digital Stimulus

Tektronix

Enabling Innovation

Data Pattern Generator

▶ DG2040 • DG2030 • DG2020A

▶ DG2000 Series Principal Specifications

	DG2040	DG2030	DG2020A
Data Rate	1.1 Gb/s	400 Mb/s	200 Mb/s
Pattern Depth	256 K/CH.	256 K/CH.	64 K/CH.
Rise & Fall Time (20% to 80%)	150 ps at 1 V_{p-p}	1.5 ns at 2.5 V_{p-p}	2 ns at 5 V_{p-p}
No. of Channels	2	4 or 8	12, 24 or 36
Features	Edge control	Variable tr & tf time	Bus wide testing

Critical Timing

The DG2000 Series is the ideal solution for applications where you must characterize device or circuit timing and amplitude margins. The DG2000 Series is perfect for simulating setup and hold violations or conditions of metastability. The DG2000 graphical user interface allows you to quickly create complex data patterns with a few keystrokes on the front panel. Use the advanced sequence editing capability of the DG2000 Series to insert infrequent faults or glitches in your data patterns to verify device or circuit recovery. The DG2000 Series is an invaluable tool, allowing you to simulate missing system functionality while meeting critical market windows. With the introduction of the DG2040, new capabilities are available to control clock and data jitter or modulate pulse edges on a selective basis (Figure 1).
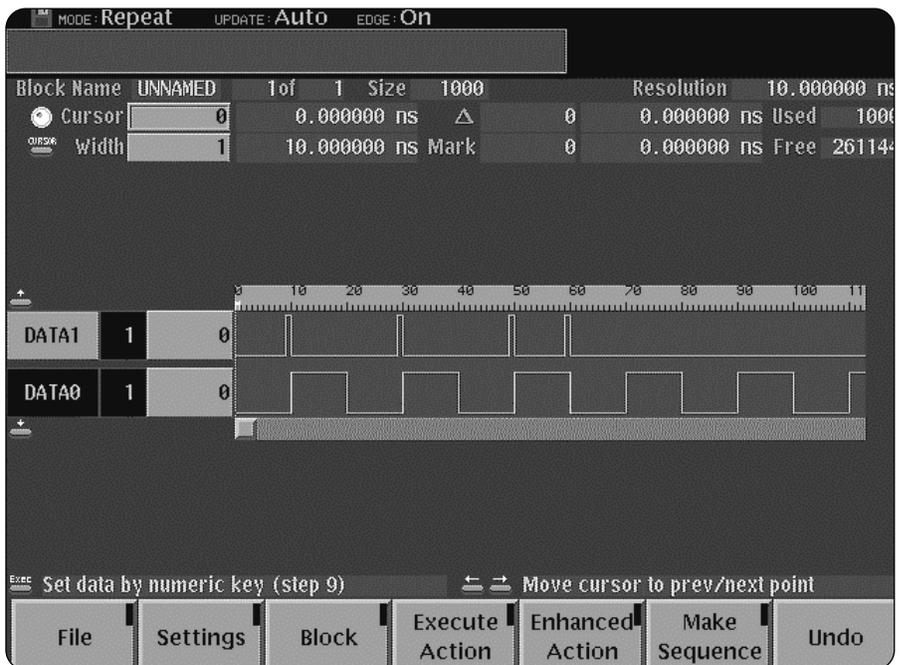
▶ **Figure 1.** *The DG2040 allows specific edges to be identified and time adjusted or jittered by ±100 ps. An external modulation source can be used to provide continuously variable jitter.*

▶ Characteristics

▶ Output Data

	DG2040	DG2030	DG2020A
Data Rate	0.1 b/s to 1100 Mb/s	0.1 b/s to 409.6 Mb/s	0.1 b/s to 200 Mb/s
Sampling Rate	0.1 Hz to 1100 MHz	0.1 Hz to 409.6 MHz	0.1 Hz to 200 MHz
Resolution	7 digits	7 digits	4 digits
Clock Output Period Jitter	<30 ps_{p-p} at 1100 MHz. Typical	<50 ps_{p-p} at 200 MHz. Typical	<50 ps_{p-p} at 200 MHz. Typical
CH0 Period Jitter (Clock Pattern)	<20 ps_{p-p} at 1100 MHz. Typical	<200 ps_{p-p} at 400 MHz. Typical	<35 ps_{p-p} at 200 MHz. Typical
Accuracy	PLL On, ±0.0001%	PLL On, ±0.0001%; PLL Off, ±3%	PLL On, ±0.005%; PLL Off, ±3%
Pattern Depth	360 to 256 Kbits (4 increment)	90 to 256 Kbits (1 increment)	64 to 64 Kbits (1 increment)
Data Width	2-Bits (complementary outputs) via front-panel SMA connectors	**Standard:** 4-Bits via front-panel BNC connectors **Optional:** 8-Bits via 4 front-panel, 4 rear-panel BNC connectors	**Standard:** 12-Bits **Optional:** 24- or 36-Bits

Sequencer

Maximum Number of Blocks – 256.

Maximum Number of Sequence Steps –
DG2040: 4000.
DG2030: 4000.
DG2020A: 2048.

Block Repeats Per Line – 1 to 65536 or infinite.

Internal Trigger Generator (DG2030, DG2040)

Range – 1.0 µs to 10.0 s.

Resolution – 3 digits, 0.1 µs minimum.

Accuracy – ±0.01%.

Data and Clock Output (DG2040)

Data –
Output:
 Standard: CH 0 & CH 1 at front-panel SMA and Clock at rear panel SMA connectors.
V_{OH}: – 0.875 V to +3.5 V into 50 Ω.
V_{OL}: –1.125 V to +3.25 V into 50 Ω.
Resolution: 5 mV.
Maximum Swing: 2.5 V_{p-p} into 50 Ω.
Minimum Swing: 250 mV_{p-p} into 50 Ω.
DC Accuracy: ±3% of set value ± 50 mV.
Aberrations:
 Overshoot <5% at 1.5 V_{p-p} at 10 MHz.
 Undershoot: <5% ±1.5 V_{p-p} at 10 MHz.

Impedance: 50 Ω.
Rise/Fall Time (20 to 80%): <150 ps at 1 V_{p-p} and 10 MHz.
Delay Function:
 Delay Channel: CH 0 or CH 1.
 Delay Time: –1 ns to +2 ns.
 Delay Resolution: 10 ps.
 Accuracy: < (±3% of setting) ± | 25 ºC – T_a | ∗ 15 ps ±100 ps (where T_a is the ambient temperature ºC).
Channel Skew: (<± | 25 ºC – T_a | ∗15 ps ±100 ps) where T_a is the ambient temperature ºC.

Data Pattern Generator

▶ DG2040 • DG2030 • DG2020A

Data and Clock Output (DG2030)

Data –

Output:

Standard: CH 0 to CH 3 and Clock at front-panel BNC connectors.

Optional: CH 4 to CH 7 at rear-panel BNC connectors.

V_{OH}: −1.25 V to +3.5 V into 50 Ω.

V_{OL}: −1.50 V to +3.25 V into 50 Ω.

Resolution: 5 mV.

Maximum Swing: 5 V_{p-p}.

Minimum Swing: 250 mV_{p-p}.

DC Accuracy: (±3% of set value) ± 50 mV.

Aberrations: ≤5% at 3.5 V_{p-p}.

Impedance: 50 Ω.

Rise/Fall Time (20 to 80%): Variable at amplitude range from 2 V_{p-p} to 5 V_{p-p}.

Variable Range: 2.1 ns to 4.7 ns at 3.00 V_{p-p} – depends on amplitude setting.

Value in Fast: 0.25 V_{p-p} to 1 V_{p-p}; 500 ps. 1.7 ns at 3.00 V_{p-p}.

Accuracy: ±10% of setting ±500 ps.

Delay Function:

Delay Channel: CH 0 to CH 7.

Delay Time: −5 ns to 18 ns.

Delay Resolution: 20 ps.

Accuracy: ±(3% of setting) ± | 25 − Ta | * 60 ps ±500 ps (where Ta is the ambient temperature ºC).

Channel Skew: <±300 ps (referenced to the clock output) at 10 MHz.

Deskew Range: ±1 ns.

Resolution: 10 ps.

Clock –

Amplitude: ±5% of setting ±50 mV at 1 MHz clock.

Aberration: ≤5% at 3.5 V_{p-p}.

Impedance: 50 Ω.

Rise/Fall Time (20 to 80%): Variable at amplitude range is 2 V_{p-p} to 5 V_{p-p}.

Variable Range: Depends on amplitude setting.

Value in Fast: 0.25 V_{p-p} to 1 V_{p-p}; 500 ps. 1.7 ns at 3.00 V_{p-p}.

Accuracy: ±10% of setting ±500 ps.

Auxiliary Inputs

Clock –

DG2040: Rear-panel BNC connectors (10 MHz reference).

DG2030: Rear-panel BNC connector.

DG2020A: Rear-panel SMB connector.

Frequency:

DG2040: 10 MHz ±0.1 MHz.

DG2030: DC to 409.6 MHz.

DG2020A: DC to 200 MHz.

DG2040 –

Input voltage range: 0.2 V to 3.0 V_{p-p}.

Input voltage level: ±10 V_{max}.

Impedance: 50 Ω, AC coupling.

DG2020A and DG2030 –

Impedance: 50 Ω, terminated to +0.5 V.

Delay to Clock Out: 36 ns (typical).

Trigger –

Front-panel BNC connector.

Level: −5.0 V to +5.0 V.

Resolution: 0.1 V.

Threshold accuracy: ±(5% of setting) ±0.1 V.

Minimum Pulse Width: ≥10 ns.

Sensitivity: >0.5 V_{p-p}.

Impedance: 1 kΩ or 50 Ω.

Maximum Input: ±10 V into 1 kΩ, ±5 V into 50 Ω.

Polarity: Positive or negative.

Hold Off:

DG2040: 100 ns minimum.

DG2030: 100 ns minimum.

DG2020A: 500 ns minimum.

Event (DG2040 and DG2030 only) –

Rear-panel BNC connector.

Threshold Level: −5.0 V to +5.0 V.

Resolution: 0.1 V.

Set-up Time to Next Block:

DG2040: 230.5 to 254.5 clocks before the next block.

DG2030: 48 to 53 clocks before the next block.

Polarity: Positive edge.

Minimum Pulse Width: 100 ns.

Inhibit (DG2030 only) –

Rear-panel BNC connector.

Mode:

Off: Always enabled.

Internal: Controlled by CH 0 signal.

External: Controlled by inhibit input signal.

Both: Controlled by CH 0 or inhibit input signal.

Threshold Level: −5.0 V to +5.0 V into 1 kΩ.

Resolution: 0.1 V.

Delay to Data Output: 34 ns to 38 ns (typical).

Delay to Clock Output: 7 ns to 11 ns (typical).

Auxiliary Outputs

Sync –

DG2040: Rear-panel BNC connector.

DG2030: Rear-panel BNC connector.

DG2020A: Front-panel BNC connector.

Level:

V_{OH}, 2.5 V into 50 Ω

V_{OL}, 0 V into 50 Ω.

Pulse Width:

DG2040: 32 to 36 clocks.

DG2030: 9 or 10 clocks.

DG2020A: 6 clocks.

Impedance: 50 Ω.

Event –
DG2040: Rear-panel BNC connector.
DG2030: Rear-panel BNC connector.
DG2020A: Front-panel BNC connector.
Level:
    DG2040: V_{HI}, 2.5 V into 50 Ω; V_{LO}, 0 V into
    50 Ω.
    DG2030: V_{OH}, 2.5 V into 50 Ω; V_{OL}, 0 V into
    50 Ω.
    DG2020A: Positive TTL pulse, 50 Ω.
Output Term:
    DG2040: 180 to 200 clocks.
    DG2030: 45 to 50 clocks.
    DG2020A: 8 clocks.
Delay Time:
    DG2040: 194.5 to 214.5 clocks before data
    output change.
    DG2030: 48 to 53 clocks before data output
    change.
    DG2020A: 22 clocks before data output change.
Impedance: 50 Ω.

Clock (DG2020A only) **–**
Rear-panel SMB connector.
Level: 1 V (typical) into 50 Ω.
Delay From Trigger Input:
    PLL On:
        >6.25 MHz: 15 to 40 ns.
        <6.25 MHz: 25 to 60 ns.
    PLL Off:
        >6.25 MHz: 15 to 45 ns.
        <6.25 MHz: 25 to 60 ns.
External: 7 ns + 1 clock to 20 ns + 0.5 clock.

Programmable Interface –
GPIB: ANSI/IEEE 488.2-1987.
RS-232-C: 19.2 Kb/s, D-sub 9-Pin connector.

P3410 TTL Data Output Pod Characteristics

Data Output
Channels – 12.

Connector – 26-Pin header.

V_{OH} **–** >4.4 V into 1 MΩ.

V_{OL} **–** >0.1 V into 1 MΩ.

Rise/Fall Time – <5 ns into 1 MΩ, 10 pF
(20% to 80%).

Internal Clock Out to Data Delay – 24 ns.

External Clock Input to Data Output Delay –
25 to 45 ns.

Trigger Input to Data Output Delay –
Internal Clock:
    >6.25 MHz: 30 to 65 ns.
    <6.25 MHz: 45 to 80 ns.
External Clock: 25 ns + 0.5 clock to 45 ns +
1.5 clock.

Delayed Channels
Delay Channel – CH 8, CH 9, CH 10, CH 11.

Delay Time – 0 to 20 ns.

Delay Resolution – 0.1 ns.

Channel Skew –
CH 0 and other channels, same pod: <3 ns.
CH 0 and CH 0, two pods of same type: <2 ns.

Event Input
Threshold Level – TTL.

Delay to Data Output – ≤50 ns + 50 clocks.

Set-up Time to Next Block – 47 to 54 clocks.

Inhibit Input
Level – TTL, 1 kΩ.

Delay to Data Output – 18 ns.

Internal Inhibit Delay – 5 ns.

Physical Characteristics

Dimensions	mm	in.
Height*[1]	51	2.0
Width	150	5.9
Depth	101	4.0
Weight	**kg**	**lb.**
Net	0.5	1.1

*[1] Including feet.

Data Pattern Generator

▶ DG2040 • DG2030 • DG2020A

P3420 Variable Data Output Pod Characteristics

Data Output
Channels – 12.

Connector – SMB.

V_{OH} **–** −2.0 V to +7.0 V into 1 MΩ.

V_{OL} **–** −3.0 V to +6.0 V into 1 MΩ.

Resolution – 0.1 V.

Maximum Swing – 9.0 V_{p-p}.

Minimum Swing – 0.5 V_{p-p}.

Output Current –
Total Output Current: <500 mA.
Sink: <−30 mA/CH.
Source: >+30 mA/CH.

Rise/Fall Time – <2 ns into 1 MΩ, 10 pF, 5 V_{p-p} swing (20% to 80%).

Internal Clock Out to Data Delay – 20 ns.

External Clock Input to Data Output Delay – 20 to 40 ns.

Trigger Input to Data Output Delay –
Internal Clock:
>6.25 MHz: 30 to 60 ns.
<6.25 MHz: 40 to 70 ns.
External Clock: 20 ns + 0.5 clock to 40 ns + 1.5 clock.

Delayed Channels
Delay Channel – CH 8, CH 9, CH 10, CH 11.

Delay Time – 0 to 20 ns.

Delay Resolution – 0.1 ns.

Channel Skew –
CH 0 and other channels, same pod: <3 ns.
CH 0 and CH 0, two pods of same type: <2 ns.

Event Input
Threshold Level – −5.0 V to +5.0 V.

Resolution – 0.1 V.

Delay to Data Output – ≤45 ns + 50 clock.

Set-up Time to Next Block – 47 to 54 clocks.

Inhibit Input
Threshold Level – −5.0 V to +5.0 V, 1 kΩ.

Resolution – 0.1 V.

Delay to Data Output – 16 ns.

Internal Inhibit Delay – −2 ns.

Physical Characteristics

Dimensions	mm	in.
Height[1]	51	2
Width	255	10
Depth	161	6.3
Weight	**kg**	**lb.**
Net	1	2.2

[1] Including feet.

General Characteristics

Environmental
Temperature –
Operating: +10 ºC to +40 ºC.
Nonoperating: −20 ºC to +60 ºC.

Humidity –
Operating: 20% to 80% (no condensation).
Nonoperating: 5% to 90% (no condensation).

Altitude –
Operating: Up to 4.5 km (15,000 ft.).
Nonoperating: Up to 15 km (50,000 ft.).

Vibration – Operating: 0.33 mm p-p, 10 to 55 Hz, 15 minutes.

Shock – Nonoperating: 294 m/s^2 (30 g), half-sine, 11 ms duration.

Certification and Compliance
EC Declaration of Conformity – Meets intent of Directive 89/336/EEC for electromagnetic compatibility.

Safety – UL1244, CSA231, EN61010-1, IEC61010-1.

Power
AC Line Power –
Voltage Ranges: 90 to 250 VAC.
Nominal Voltage: 100 V, 115 V, 200 V, 230 V, 240 V.
Line Frequency:
90 to 250 VAC: 48 to 63 Hz.
90 to 127 VAC: 48 to 440 Hz.

Power Consumption – 300 W maximum.

Maximum Current – 4 A.

Physical Characteristics
DG2000 SERIES MAIN FRAME

Dimensions	mm	in.
Height[1]	164	6.4
Width[2]	362	14.3
Depth[3]	491	8.25
Weight	**kg**	**lb.**
Net	9.7	21.4

[1] Including feet.

[2] Including handle.

[3] Including front cover. 576 mm (22.2 in.) with handle extended.

Characteristics shown are typical. Please refer to individual product user manuals for complete specifications.

▶ Ordering Information

DG2040

Data Generator.

Includes: User Manual (071-0257-50), Programmer Manual (071-0258-50), 3.5 in. Performance Check Disk (063-3121-50), GPIB Sample Program Disk (063-3122-50), DG-link Application Software (063-2920-50), Power Cord, ISO Qualified Inspection Passed Certificate.

Please specify power plug when ordering.

Options

Opt. 1R – Rackmount. Floppy drive access moved to front panel.

DG2030

Data Generator.

Includes: User Manual (071-0059-50), Programmer Manual (071-0057-50), 3.5 in. Performance Check Disk (063-2922-50), GPIB Sample Program Disk (063-2921-50), DG-link Application Software (063-2920-50), Power Cord, ISO Qualified Inspection Passed Certificate.

Please specify power plug when ordering.

Options

Opt. 01 – Eight-channel output. Adds four-channel output from rear panel.

Opt. 1R – Rackmount. Floppy drive access moved to front panel.

DG2020A

Data Generator.

Includes: User Manual (071-0053-50), Programmer Manual (071-0054-50), 3.5 in. Performance Check Disk (063-2918-50), GPIB Sample Program (063-2919-50), DG-Link Application Software (063-2920-50), Pod Connection Cable (174-3548-00), Power Cord, ISO-qualified Inspection Passed Certificate. Order P3410 or P3420 Pod separately.

Please specify power plug when ordering.

Options

Opt. 01 – Adds a 12-Bit digital port for a total of 24 output channels. Includes pod connection cables (174-3548-00). Order P3410 or P3420 pod separately.

Opt. 02 – Adds two 12-Bit digital ports for a total of 36 output channels. Includes two pod connection cables (174-3548-00). Order P3410 or P3420 pod separately.

Opt. 1R – Rackmount. Floppy drive moved to front panel.

Recommended Accessories

P3410

TTL-level Pod with 12 Output Channels.

Includes: Pin Header-to-Pin Header Output Cable Set (012-1502-00) for 12 Output Channels, ISO Qualified Inspection Passed Certificate.

P3420

Variable-level Pod with 12 Output Channels.

Includes: SMB-to-Pin Header Output Cable Set (012-1504-00) for 12 output channels, ISO Qualified Inspection Passed Certificate.

DG2000 Series

Power Plug Options

Opt. A0 – US Plug, 115 V, 60 Hz.

Opt. A1 – Euro Plug, 220 V, 50 Hz.

Opt. A2 – UK Plug, 240 V, 50 Hz.

Opt. A3 – Australian Plug, 240 V, 50 Hz.

Opt. A4 – N. American Plug, 240 V, 50 Hz.

Opt. A5 – Swiss Plug, 220 V, 50 Hz.

DG2000 Series Service

Opt. C3 – Calibration Service 3 Years.

Opt. D1 – Calibration Data Report.

Opt. D3 – Calibration Data Report 3 Years (with Option C3).

Opt. R3 – Repair Service 3 Years.

P3410 and P3420 POD

Service

Opt. D1 – Calibration Data Report.

Opt. R3 – Repair Service 3 Years.

Recommended Accessories

PODS (DG2020A)

Cables, Adapters and Connectors

SMB-to-Pin Header Cable (20 in.) – Order 012-1503-00.

SMB-to-Pin Header Cable (50 in.) – Order 012-1506-00.

Pin Header-to-Pin Header Cable – Order 012-1505-00.

SMB-to-SMB Cable (40 in.) – Order 012-1458-00.

50 Ω **BNC-to-BNC Cable (Single shield) –** Order 012-1342-00.

50 Ω **BNC-to-BNC Cable (Double shield) –** Order 012-1256-00.

50 Ω **BNC-to-SMB Cable (40 in.) –** Order 012-1459-00.

50 Ω **BNC Male-to-SMB Female Adapter –** Order 015-0671-00.

One-channel Pin Lead Set (Set of 5) – Order 012-1508-00.

Four-channel Pin Lead set (Set of 3) – Order 012-1509-00.

Connector (for Pin-header) – Order 131-5919-00.

GPIB Cable – Order 012-0991-00.

Replacement 1.2 m POD Connection Cable (standard accessory) – Order 174-3548-00.

50 Ω **SMA male to SMA male; 12 in. –** Order 174-1364-00.

50 Ω **SMA male to SMA male; 20 in. –** Order 174-1427-00.

50 Ω **SMA male to SMA male; 60 in. –** Order 174-1428-00.

50 Ω **SMA male to SMA male; 2 m –** Order 174-0679-00.

50 Ω **SMA male to SMA male; 8.5 in. –** Order 174-1120-00.

50 Ω **SMA male to SMA male; 1 m –** Order 174-1341-00.

Documentation

DG2020A Service Manual – Order 071-0055-50.

DG2030 Service Manual – Order 071-0058-50.

DG2040 Service Manual – Order 071-0259-50.

DG2020A Twelve-Channel Upgrade Kit (Provides same function as DG2020A Opt. 01) – Order 040-1556-50.

Warranty – One year parts and labor.

Data Pattern Generator
▶ DG2040 • DG2030 • DG2020A

Our most up-to-date product information is available at:
www.tektronix.com

Product Area Assessed: The planning, design/development and manufacture of electronic Test and Measurement instruments.

Product(s) complies with IEEE Standard 488.1-1987, RS-232-C, and with Tektronix Standard Codes and Formats.

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