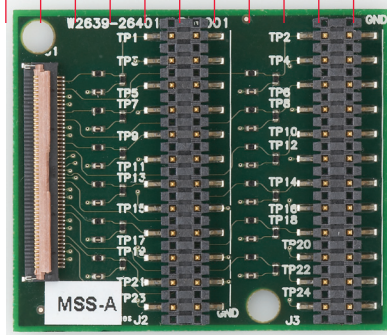
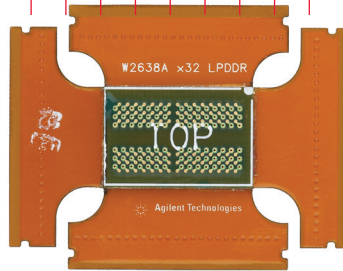
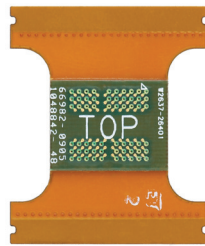
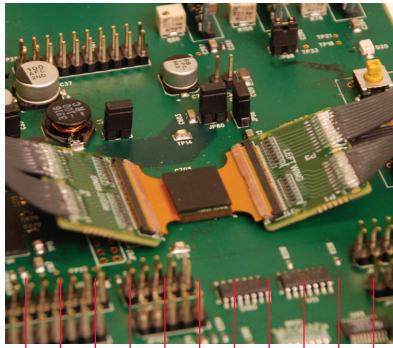


# Keysight Technologies

## W2637A, W2638A and W2639A

### LPDDR BGA Probes for Logic Analyzers and Oscilloscopes

Data Sheet



#### Introduction

The W2637A, W2638A and W2639A LPDDR BGA probes provide signal accessibility and probing of embedded memory designs directly at the ball grid array (BGA) package.

The Keysight Technologies, Inc. LPDDR BGA probes enable viewing of data traffic on industry standard LPDDR SDRAM, LPDDR NVM and mobile-DDR DRAM with the Keysight 16900 Series logic analysis system and Infiniium 9000 and 90000 Series oscilloscopes.



Features	Benefits
Provides signal accessibility points for the LPDDR SDRAM, LPDDR NVM and mobile-DDR DRAM ball grid array (BGA) package.	Eliminates reflections from mid-bus probing methods. Also eliminates board space and trace routing required for connector probing methods.
Supports: <ul style="list-style-type: none"> <li>- x16 package (60 balls) all signals</li> <li>- x32 package (90 balls) all signals</li> </ul> Note: Please refer to Table 1, 2, 3 and 4 for pin-out information.	Get complete signal access to the LPDDR signals critical to your debug and validation effort.
Buried resistors provide signal isolation and minimize capacitive loading.	Acquire high-speed signals without impacting the performance of your design. The LPDDR BGA probe provides a non-intrusive electrical and mechanical between the memory device and an Keysight instrument.
Operating transfer rate of up to 400 Mb/s 1.5 GHz bandwidth	Operate at full speed whether you're making measurements with a logic analyzer or oscilloscope.
Works with existing designs	Eliminates need for re-design or up front planning
Supports either leaded or lead-free solder	Easily works with all solder finishes. Designed to tolerate lead-free soldering temperature profiles.
Contract manufactures available for those without the in-house expertise or facilities for soldering BGAs	Eliminates the need to develop BGA soldering expertise.
Flexible "wings" with ZIF connectors	Ensures reliable connection to the ZIF probes. Enables placement of the probe cables around adjacent components. Minimizes the torque to the balls of the BGA
Attach to E5384A, and E5826A, single-ended ZIF probes for connection to the logic analyzer	Optimizes the use of logic analyzer channels by allowing assignments of channels to
Probe points available for oscilloscope E2678A socket probe head to the W2639A scope adapter board that connects to the flex-rigid of the LPDDR BGA probe	Enables oscilloscope probing of the DRAM signals with Keysight Infiniium 9000 and 90000 Series oscilloscope, giving you a LPDDR compliance test solution covering clock, electrical and timing parameters of the JEDEC specification.

## LPDDR BGA Connection to an Keysight Logic Analyzer

The W2637A LPDDR BGA probe connects to E5384A to provide connection to the logic analyzer for the x16 LPDDR package. The W2638A LPDDR BGA probe connects connection to the logic analyzer to E5384A and E5826A to provide for the x32 LPDDR package.



Figure 1. E5384A 46-ch single-ended ZIF probe for x16 and x32 DRAM BGA probe connects to 90-pin logic analyzer cables.

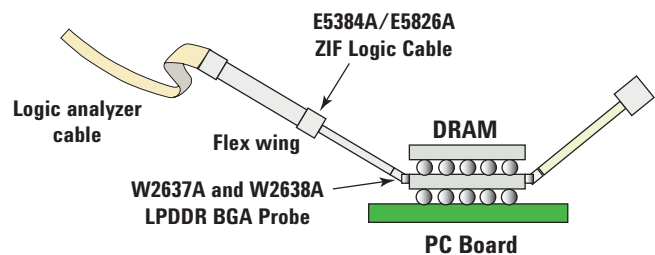


Figure 2. Probe connection to the logic analyzer

## LPDDR BGA Connection to a Keysight Oscilloscope

The LPDDR BGA probe is used with W2639A scope adapter board and the E2678A scope socket probe head to connect to the oscilloscope. The scope socket probe head is attached to the pin headers on the scope adapter board. The scope socket probe head makes a 1.5 GHz bandwidth connection with the solder points on the BGA probe.

The other alternative is using the W3635A scope probe adapter board and the N5425/26/51A ZIF tips. This method requires the ZIF tips to be soldered to the test points on the W3635A.

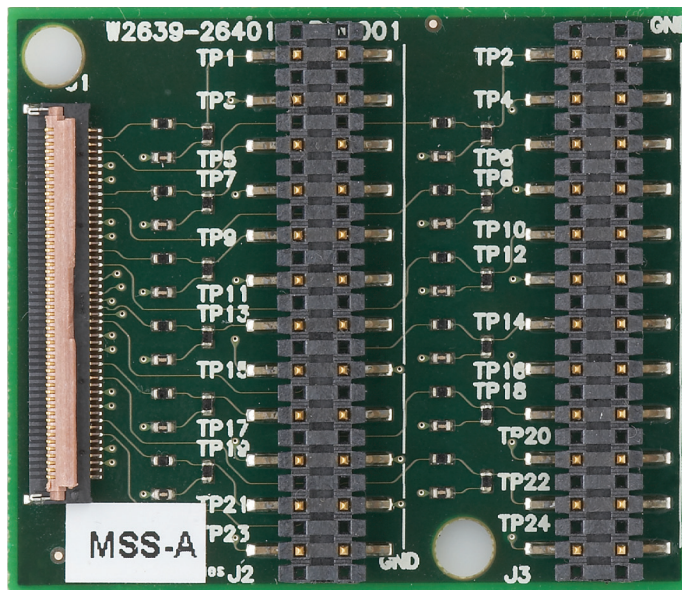


Figure 3. W2639A LPDDR scope probe adapter board with test points for connection to oscilloscope

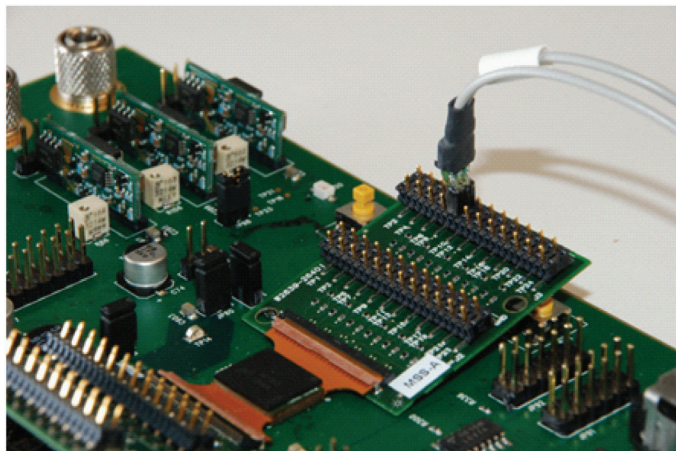


Figure 4. W2637A LPDDR BGA probe connection to the scope through W2639A LPDDR scope probe adapter board and E2678A socket probe head.

## LPDDR BGA Probe Pin-Out to Logic Analyzer

Left Flex Wing (E5384A)		
Pin	Signal Name	Group
All odd Pins	GND	-
2	NC	-
4	DQ14	Data
6	DQ15	Data
8	DQ13	Data
10	DQ12	Data
12	UDQS	Data
14	DQ10	Data
16	DQ9	Data
18	DQ8	Data
29	DQ11	Data
22	UDM	Data
24	LDM	Data
26	NC	-
28	LDQS	Data
30	BAD	Command
32	CS#	Command
34	A9	Address
36	A7	Address
38	A6	Address
40	A8	Address
42	A4	Address
44	A5	Address
46	NC	-
48	NC	-
50	GNG	-

Right Flex Wing (E5384A)		
Pin	Signal Name	Group
All odd pins	GND	-
100	GND	-
98	DQ0	Data
96	DQ1	Data
94	DQ2	Data
92	DQ3	Data
90	GND	-
88	CKE	Command
86	DQ5	Data
84	DQ6	Data
82	DQ4	Data
80	DQ7	Data
78	CK	Command
76	CK#	Command
74	RAS#	Command
72	WE#	Command
70	CAS#	Command
68	BA1	Command
66	A13	Address
64	A12	Address
62	A11	Address
60	A1	address
58	A0	Address
56	A10	Address
54	A3	Address
52	A2	Address

Table 1. W2637A x16 LPDDR BGA Probe Pin-Out

Left flex wing (E5384A)		
Pin	Signal Name	Group
All odd Pins	GND	-
2	DM3	Data
4	DQ31	Data
6	DQ29	Data
8	DQ27	Data
10	DQ25	Data
12	DQS2	Data
14	DQ9	Data
16	DQ11	Data
18	DQ13	Data
20	DQ15	Data
22	DM2	Data
24	WE#	Command
26	CAS#	Command
28	RAS#	Command
30	DM1	Data
32	DQS1	Data
34	A9	Address
36	A11	Address
38	A12	Address
40	A6	Address
42	A7	Address
44	A8	Address
46	A4	Address
48	A5	Address
50	GND	-

Right flex wing (E5384A)		
Pin	Signal Name	Group
Add odd Pins	GND	-
100	GND	-
98	DQ16	Data
96	DQ18	Data
94	DQ20	Data
92	DQ22	Data
90	GND	-
88	CKE	Command
86	DQ6	Data
64	DQ4	Data
82	DQ2	Data
80	DQ0	Data
78	CS#	Command
76	GND	-
74	BA1	Command
72	BA0	Command
70	DM0	Data
68	DQS0	Data
66	NC	-
64	NC	-
62	NC	-
60	A1	Address
58	A0	Address
56	A10	Address
54	A3	Address
52	A2	Address

Table 2. W2638A x32 LPDDR BGA Probe Pin-Out (continued on next page)

Bottom flex wing (E5826A)		
Pin	Signal Name	Group
All odd Pins	GND	-
102	NC	-
104	DQ8	Data
106	DQ10	Data
108	DQ12	Data
110	DQ14	Data
112	NC	-
114	DQ1	Data
116	DQ3	Data
118	DQ5	Data
120	DQ7	Data
122	NC	-
124	NC	-
126	NC	-
128	NC	-
130	NC	-
132	NC	-
134	NC	-
136	NC	-
138	NC	-
140	NC	-
142	NC	-
144	NC	-
46	NC	-
148	NC	-
150	GND	-

Top flex wing (E5826A)		
Pin	Signal Name	Group
Add odd Pins	GND	-
200	GND	-
198	DQ24	Data
196	DQ26	Data
194	DQ28	Data
192	DQ30	Data
190	GK#	Command
188	CK	Command
186	DQ17	Data
164	DQ19	Data
182	DQ21	Data
180	DQ23	Data
178	NC	-
176	NC	-
174	NC	-
172	NC	-
170	NC	-
168	NC	-
166	NC	-
164	NC	-
162	NC	-
160	NC	-
158	NC	-
156	NC	-
154	NC	-
152	NC	-

Table 2. W2638A x32 LPDDR BGA Probe Pin-Out

## LPDDR Scope Probe Adapter Pin-Out for Scope

Left Flex wing						Right Flex Wing					
Signal Name	Signal Name	Test point	Signal Name	Signal Name	Test point	Test Point	Signal Name	Signal Name	Test Point	Signal Name	Signal Name
GND	DQ14	TP1	GND	NC	TP2	TP24	DQ0	GND	TP23	DQ1	GND
GND	DQ13	TP3	GND	DQ15	TP4	TP22	DQ2	GND	TP21	DQ3	GND
GND	DQ10	TP5	GND	DQ12	TP6	TP20	GND	GND	TP19	DQ5	GND
GND	DQ9	TP7	GND	UDQS	TP8	TP18	CKE	GND	TP17	DQ6	GND
GND	DQ11	TP9	GND	DQ8	TP10	TP16	DQ4	GND	TP15	DQ7	GND
GND	NC	TP11	GND	UDM	TP12	TP14	CK	GND	TP13	RAS#	GND
GND	LDQS	TP13	GND	LDM	TP14	TP12	CK#	GND	TP11	WE#	GND
GND	CS#	TP15	GND	BA0	TP16	TP10	CAS#	GND	TP9	BA1	GND
GND	A6	TP17	GND	A9	TP18	TP8	A13	GND	TP7	A11	GND
GND	A8	TP19	GND	A7	TP20	TP6	A12, NC	GND	TP5	A1	GND
GND	A5	TP21	GND	A4	TP22	TP4	AO	GND	TP3	A10	GND
GND	NC	TP23	GND	NC	TP24	TP2	A3	GND	TP1	A2	GND

Table 3. W2639A LPDDR BGA Probe Adapter Board Pin-Out for W2637A x16 LPDDR BGA Probe

Left Flex wing					
Signal Name	Signal Name	Test point	Signal Name	Signal Name	Test point
GND	DM3	TP1	GND	DQ31	TP2
GND	DQ29	TP3	GND	DQ27	TP4
GND	DQ25	TP5	GND	DQ9	TP6
GND	DQS2	TP7	GND	DQ11	TP8
GND	DQ13	TP9	GND	DQ15	TP10
GND	DM2	TP11	GND	CAS#	TP12
GND	WE#	TP13	GND	RAS#	TP14
GND	DM1	TP15	GND	DQS1	TP16
GND	A9	TP17	GND	A12	TP18
GND	A11	TP19	GND	A6	TP20
GND	A7	TP21	GND	A8	TP22
GND	A4	TP23	GND	A5	TP24

Right Flex Wing					
Test Point	Signal Name	Signal Name	Test Point	Signal Name	Signal Name
TP24	DQ16	GND	TP23	DQ18	GND
TP22	DQ20	GND	TP21	DQ22	GND
TP20	GND	GEN	TP19	DQ6	GND
TP18	CKE	GND	TP17	DQ4	GND
TP16	DQ2	GND	TP15	DQ0	GND
TP14	CS#	GND	TP13	BA1	GND
TP12	GND	GND	TP11	BA0	GND
TP10	DM0	GND	TP9	DQS0	GND
TP8	NC	GND	TP7	NC	GND
TP6	NC	GND	TP5	A1	GND
TP4	AO	GND	TP3	A10/AP	GND
TP2	A3	GND	TP1	A2	GND

Bottom Flex wing					
Signal Name	Signal Name	Test point	Signal Name	Signal Name	Test point
GND	NC	TP1	GND	DQ8	TP2
GND	DQ10	TP3	GND	DQ12	TP4
GND	DQ14	TP5	GND	DQ1	TP6
GND	NC	TP7	GND	DQ3	TP8
GND	DQ5	TP9	GND	DQ7	TP10
GND	NC	TP11	GND	NC	TP12
GND	NC	TP13	GND	NC	TP14
GND	NC	TP15	GND	NC	TP16
GND	NC	TP17	GND	NC	TP18
GND	NC	TP19	GND	NC	TP20
GND	NC	TP21	GND	NC	TP22
GND	NC	TP23	GND	NC	TP24

Top Flex Wing					
Test Point	Signal Name	Signal Name	Test Point	Signal Name	Signal Name
TP24	DQ24	GND	TP23	DQ26	GND
TP22	DQ28	GND	TP21	DQ30	GND
TP20	CK#	GND	TP19	DQ17	GND
TP18	CK	GND	TP17	DQ19	GND
TP16	DQ21	GND	TP15	DQ23	GND
TP14	NC	GND	TP13	NC	GND
TP12	NC	GND	TP11	NC	GND
TP10	NC	GND	TP9	NC	GND
TP8	NC	GND	TP7	NC	GND
TP6	NC	GND	TP5	NC	GND
TP4	NC	GND	TP3	NC	GND
TP2	NC	GND	TP1	NC	GND

Table 4. W2639A LPDDR BGA Probe Adapter Board Pin-Out for W2638A x32 LPDDR BGA Probe



## Electrical Characteristics

The following is the typical electrical characteristics of the LPDDR BGA probes.

Table 1 Electrical characteristics

Operating Transfer Rate	W2637A + E5384/E5826 : 255 Mb/s
	W2638A + E5384/E5826 : 255 Mb/s
	W2637A + W2639A : 500 Mb/s
	W2638A + W2639A : 500 Mb/s
Bandwidth (3 dB)	W2637A + E5384/E5826 : 510 MHz
	W2638A + E5384/E5826 : 510 MHz
	W2637A + W2639A : 1.5 GHz
	W2638A + W2639A : 1.5 GHz
Rise time	W2637A + E5384/E5826 : 686 ps
	W2638A + E5384/E5826 : 686 ps
	W2637A + W2639A : 233 ps
	W2638A + W2639A : 233 ps
Input Impedance	W2637A + W2639A : 200 Ω
	W2638A + W2639A : 200 Ω

## LPDDR BGA Probes and Accessories

Product	Description
W2637A-101	LPDDR x16 0.8mm BGA command and data probes for logic analyzer and oscilloscope - kit of 1 probe
W2637A-102	LPDDR x16 0.8mm BGA command and data probes for logic analyzer and oscilloscope - kit of 2 probes
W2637A-104	LPDDR x16 0.8mm BGA command and data probes for logic analyzer and oscilloscope - kit of 4 probes
W2638A-101	LPDDR x32 0.8mm BGA command and data probes for logic analyzer and oscilloscope - kit of 1 probes
W2638A-102	LPDDR x32 0.8mm BGA command and data probes for logic analyzer and oscilloscope - kit of 2 probes
W2638A-104	LPDDR x32 0.8mm BGA command and data probes for logic analyzer and oscilloscope - kit of 4 probes
W2639A	LPDDR BGA scope probe adapter board – a kit of 2 boards (1 kit required for W2637A and 2 kits required for W2638A)

## Logic Analyzer Configuration Guide

DRAM type	Data width	Access to signals	Access to signals	Cables	Logic Analyzer	Order summary
x16	x16	Command, Address and Data	W2637A	E5384A	16950Bx1	16950B: 1 E5384A: 1 W2637A
x32	x32	Command, Address and data	W2638A	E5384A	16950Bx2	16950B:1 E5384A:1
		Data		E5826A		E5826A:1 W2638A

## Logic Analyzer Ordering Information

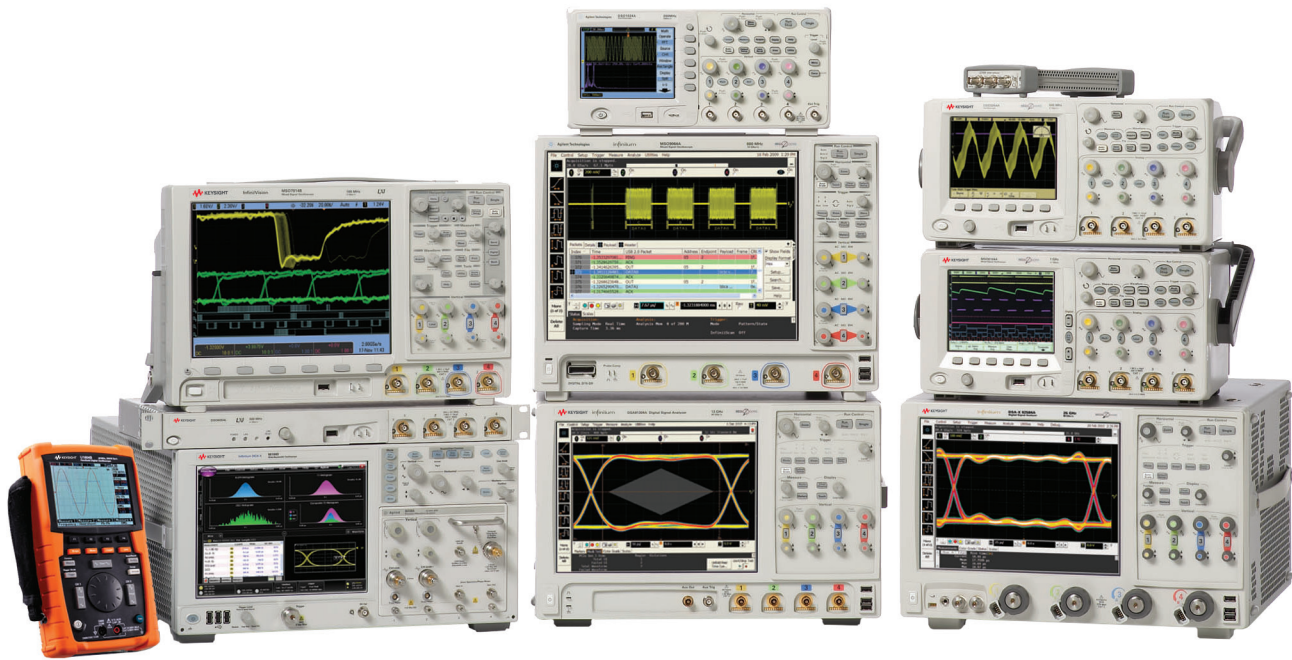
Product	Description
<b>16900 Series Logic Analyzer</b>	
16900A	6-slot mainframe, requires external display
16901A	2-slot mainframe, with 15-inch display with touch screen
16902B	6-slot mainframe, with 15-inch display with touch screen
<b>Logic Analyzer Modules</b>	
16950B	68-channel 4 GHz timing, 667 MHz state logic analysis module
<b>Logic analyzer ZIF probes</b>	
E5384A	46-channel single-ended ZIF probe for x16/x32 LPDDR DRAM BGA probe, connect to 90-pin logic analyzer cable
E5826A	46-channel single-ended ZIF probe for x32 LPDDR DRAM BGA probe, connect to logic analyzer cable

## Oscilloscope Ordering Information

Product	Description
<b>90000 Series Oscilloscope</b>	
91304A	13 GHz 4 channels 20 GSa/s Infiniium oscilloscope
91204A	12 GHz 4 channels 20 GSa/s Infiniium oscilloscope
90804A	8 GHz 4 channels 20 GSa/s Infiniium oscilloscope
90604A	6 GHz 4 channels 20 GSa/s Infiniium oscilloscope
90404A	4 GHz 4 channels 20 GSa/s Infiniium oscilloscope
90254A	2.5 GHz 4 channels 20 GSa/s Infiniium oscilloscope
<b>9000 Series Oscilloscope</b>	
9404A	4 GHz 4 channels 10 GSa/s Infiniium oscilloscope
9254A	2.5 GHz 4 channels 10 GSa/s Infiniium oscilloscope
9104A	1 GHz 4 channels 10 GSa/s Infiniium oscilloscope
<b>Oscilloscope Probes Amplifier</b>	
1169A	12 GHz InfiniiMax differential probe amplifier
1168A	10 GHz InfiniiMax differential probe amplifier
1134A	7 GHz InfiniiMax differential probe amplifier
1132A	5 GHz InfiniiMax differential probe amplifier
1131A	3.5 GHz InfiniiMax differential probe amplifier
1130A	1.5 GHz InfiniiMax differential probe amplifier
<b>DDR Application Software</b>	
U7233A	DDR and LPDDR Compliance Test Application Software
N5413A	DDR2 Compliance Test Application Software
U7231A	DDR3 Compliance Test Application Software
N5414A	InfiniiScan Event Identification Software

## Related Literature

Publication Title	Publication Type	Publication Number
<i>Keysight W2637A, W2638A and W2639A LPDDR BGA Probe</i>	Manual	W2637-97000
<i>Keysight Technologies 16900 Series Logic Analysis System</i>	Data sheet	5989-0420EN
<i>Keysight Technologies Infiniium DSO90000 Series Oscilloscopes and InfiniiMax Series Probes</i>	Data sheet	5989-7819EN
<i>Keysight Technologies U7233A DDR1 and LPDDR1 Compliance Test Application for Infiniium Series Oscilloscope</i>	Data sheet	5989-7366EN
<i>Keysight Technologies N5413A DDR2 Compliance Test Application for Infiniium Series Oscilloscope</i>	Data sheet	5989-3195EN
<i>Keysight Technologies U7231A DDR3 Compliance Test Application for Infiniium Series Oscilloscope</i>	Data sheet	5989-7243ED
<i>A Time-Saving Method for Analyzing Signal Integrity in DDR Memory Buses</i>	Application note	5989-6664EN



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