



The new generation Turbo Pumps  
with Agilent Floating Suspension

# AGILENT TWISTORR FS TURBO PUMPS

**AGILENT QUALITY ASSURED**

**NEW**

The Measure of Confidence



**TwisTorr 84 FS**

**TwisTorr 304 FS**




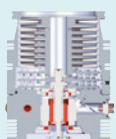




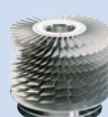

**Agilent Technologies**

# Agilent TwisTorr FS Turbo Pumps

## Agilent Quality Assured

### A new category of Turbomolecular Pumps

The TwisTorr 84 FS and 304 FS are compact, reliable, energy efficient best-in-class 80 and 300 l/s Turbo drag packages, with innovative, breakthrough technologies leading to outstanding performance, and designed for reliability, to meet highest quality standard.

2015		<b>Agilent expands the TwisTorr family with the new 84 FS</b>
2013		<ul style="list-style-type: none"><li>Agilent launches the TwisTorr 304 FS with Floating Suspension, the patented innovative, most reliable and high performing 300 L/s pump in the market</li></ul>
2010		<ul style="list-style-type: none"><li>Agilent Technologies, having acquired Varian, presents the new TwisTorr molecular drag technology based on its well-known hybrid Turbo Molecular Pump design, introducing a spiral drag section that achieves unmatched performance in both pumping speed and compression ratio in the most compact space available. New state-of-the-art electronics complete this industry leading Turbomolecular Pump innovation</li></ul>
2004		<ul style="list-style-type: none"><li>Varian develops a dedicated range of SEM products that meets the most stringent requirements of the industry</li></ul>
2003		<ul style="list-style-type: none"><li>With the Turbo-V 2K-G Varian, now Agilent, introduces a fully integrated Turbo pumping system</li></ul>
1996		<ul style="list-style-type: none"><li>Introduction by Varian of microprocessor-based on-board controller units: Navigator line, for computer driven plug-and-pump operation</li></ul>
1991		<ul style="list-style-type: none"><li>Varian introduces a new hybrid type Turbomolecular Pump: one monolithic rotor provides both high speed (Turbo stages) and high foreline tolerance (MacroTorr stages)</li><li>Use of ceramic ball bearings with life-time lubrication using a proprietary dry solid lubricant</li></ul>
1986		<ul style="list-style-type: none"><li>Varian begins collaboration with Elettrorava for turbomolecular pump technology and know-how transfer</li></ul>



### Agilent Quality and Reliability

#### Your Benefit

- Reduced cost of ownership and system down-time
- Improved reliability
- Proven robustness
- Agilent quality standards

#### 84FS Features

- Agilent Floating Suspension (FS)
- Optimized thermal design
- Precise positioning of bearings and rotor



### Easy System Integration

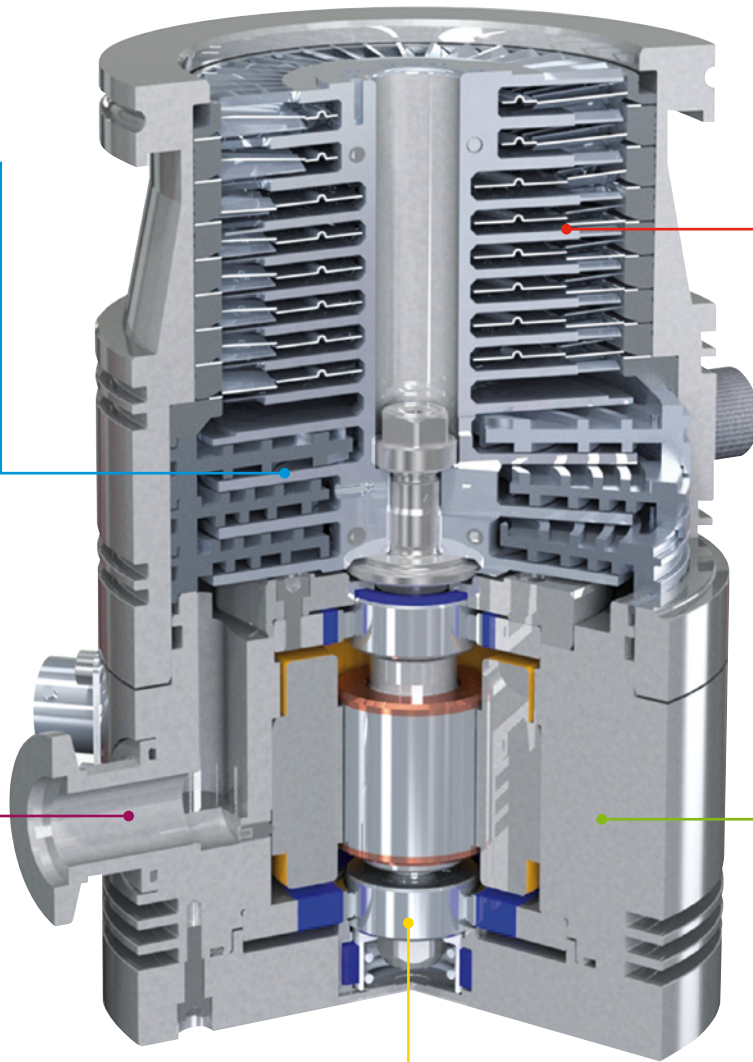
#### Your Benefit

- Compact design
- Plug & play
- Easy pump driving and monitoring
- Operation in any position
- Oil-free solution

#### 84FS Features

- Ceramic ball bearings with permanent lubrication
- PCB, Onboard, Rack Control Units with Serial and Profibus communication
- Retrofitable to any pump of similar size

# Your solution for high performance, quality, and reliability



## Superior Performance

### Your Benefit

- Low ultimate pressure
- Fast pumpdown
- Smaller/less expensive backing pump
- Suitable for high gas load applications
- Lower power consumption

### 84FS Features

TwisTorr Drag Stages allow for:

- Superior compression ratio
- High foreline pressure tolerance
- Best-in-class pumping speed



## Quiet and Low-Vibration

### Your Benefit

- Excellent vibration level (damping effect)
- Quiet pump during operation

### 84FS Features

- Agilent Floating Suspension

#### How Quiet is the TwisTorr 84 FS?

Noise	dBA
Chainsaw; thunder clap	120
Car horn (1m); live rock music	110
Lawn mower; airplane take off (1km)	100
Motorcycle (8m away)	90
Freight train (25m); food blender	80
Cars on freeway; vacuum cleaner	70
Air conditioner (30m); office noise	60
Rotary Vane Pump	55
IDP-15, or conversation at home	50
Competitor's Pump	48
Library or TWISTORR 84 FS	40



## Stability Over Time

### Your Benefit

- Stable noise and vibration performance over time.

### 84FS Features

- Agilent Floating Suspension
- Bearings and rotor stable/constant positioning over time

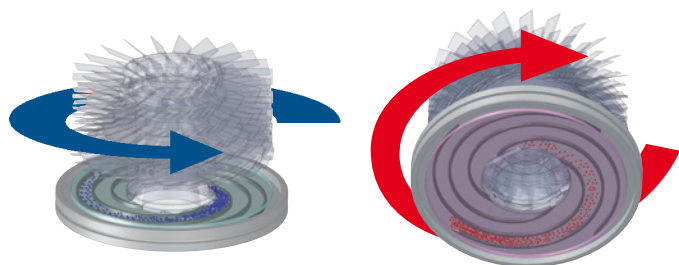
# What is TwisTorr?

The new molecular-drag technology

## Agilent TwisTorr Technology\*

- Pumping effect is created by a spinning rotor disk which transfers momentum to gas molecules.
- Gas molecules are forced to follow spiral groove design on the stator. The specific design of the channel ensures constant local pumping speed and avoids reverse pressure gradients, minimizing power consumption.

(\*) US Patents applications 12/343961 and 12/343980, 24 Dec. 2008.



### Centripetal pumping action

Lower surface area of rotating disk transfers momentum to gas molecules.

Spiral groove design on the upper section of the TwisTorr stator causes a **centripetal** pumping action (**Blue** colored gas flow).

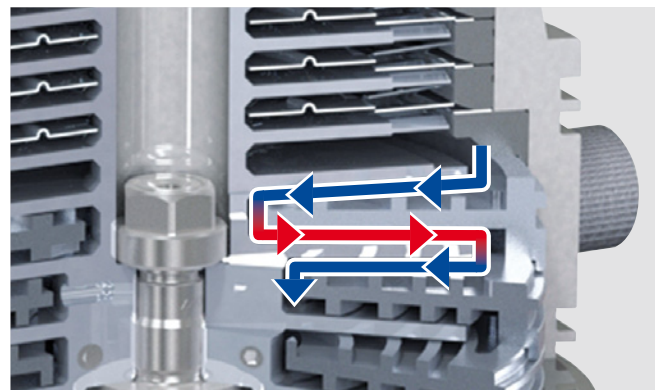
### Centrifugal pumping action

Upper surface area of rotating disk transfers momentum to gas molecules.

Spiral groove design on the lower section of the TwisTorr stator causes a **centrifugal** pumping action (**Red** colored gas flow).

## Leading Edge Performance

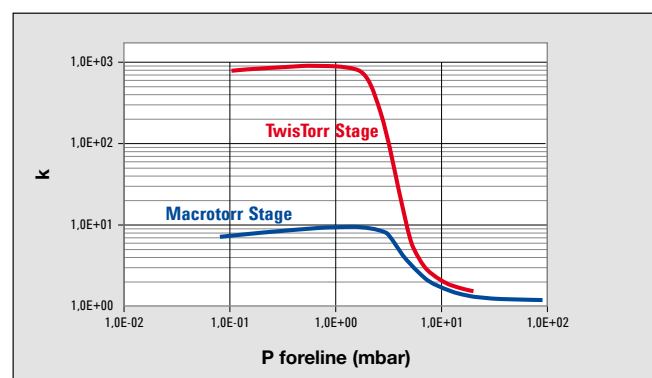
- The TwisTorr Pumps offer the highest pumping speed in their category for all gases.
- The state of the art TwisTorr technology also achieves the highest compression ratios for light gases in a commercially available Turbo Molecular Pump.
- While offering the highest performance, average power consumption by the new drag section design is reduced by a factor of x4, compared to previous designs.



Gas flow in centripetal and centrifugal direction through TwisTorr channels

## Space Saving Design

- Our rotor is based on the proven Agilent monolithic rotor design which positions the TwisTorr Stator between two smooth spinning disks and therefore exploits the pumping action by both disk surfaces in series.
- The double-sided spiral groove design on the TwisTorr stators combines centripetal and centrifugal pumping action in series, greatly reducing the size of the drag section.



## Compression ratio

- Compression ratio for N<sub>2</sub> of a single TwisTorr stage can increase up to a factor of 100 with respect to a MacroTorr stage of the same space and rotor speed, without reducing foreline tolerance and pumping speed.

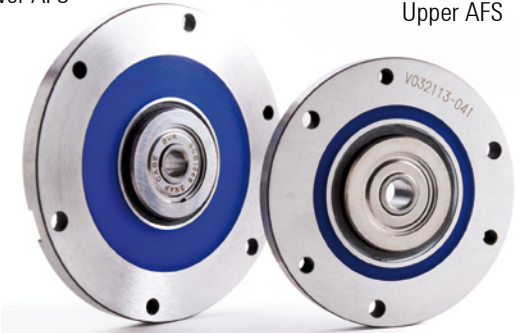


# Agilent Floating Suspension

Innovative solutions for low vibration and stability over time

Lower AFS

Upper AFS

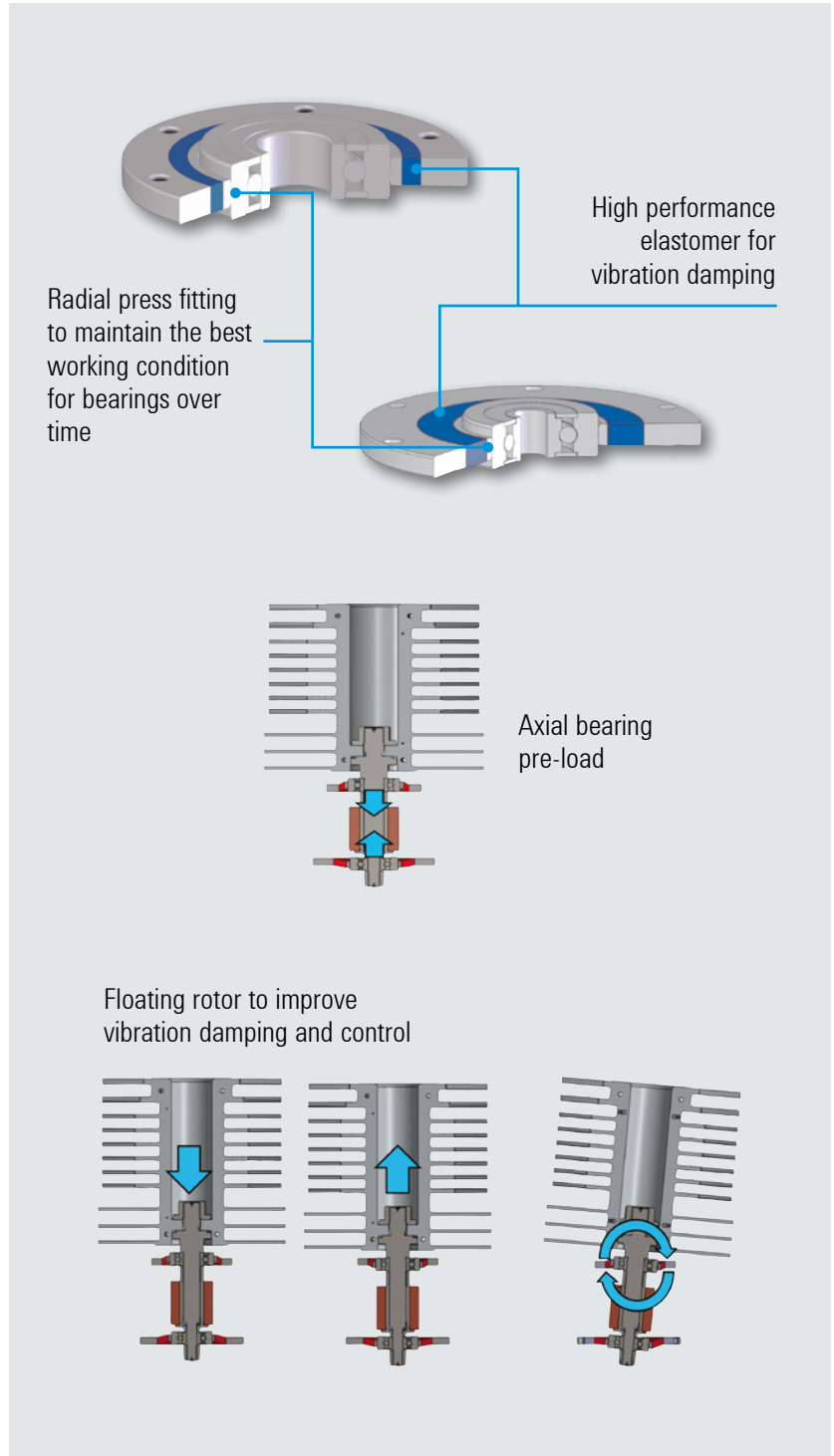


## To ensure

- Low vibration and acoustical noise
- Optimal working conditions for the bearings, extended operating life
- Exceptional stability for the very demanding SEM application



- AFS geometrical precision guarantees perfect bearing alignment
- Designed radial and axial stiffness, optimized rotor dynamic behaviour and acoustic noise
- Lower AFS acts as an axial spring providing bearing preload and axial rotor positioning
- Thermal stability



# Agilent TwisTorr 84 FS



## Technical Specifications

Pumping speed		KF40	CFF 2.75"	ISO 63	CFF 4.5"
Ar	l/s	44	57	66	66
N <sub>2</sub>	l/s	49	56	67	67
He	l/s	38	46	63	63
H <sub>2</sub>	l/s	36	40	53	53

Gas throughput at full rotational speed (with recommended forepump)		Air cooling (35°C)	Water Cooling (25°C, 65 l/h)
N <sub>2</sub>		100 sccm	100 sccm
Ar		70 sccm	70 sccm

Compression ratio & Foreline Tolerance		
Ar		$> 1.0 \times 10^{11}$ >14 mbar
N <sub>2</sub>		$\geq 1.0 \times 10^{11}$ >14 mbar
He		$2.0 \times 10^6$ >12 mbar
H <sub>2</sub>		$5.0 \times 10^4$ >4 mbar

Base pressure with recommended forepump (5 m <sup>3</sup> /h)	< 8 E-10 mbar (< 6.0 x 10 <sup>-10</sup> Torr)
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Inlet flange	CFF 4.5" O.D.	ISO 63
	CFF 2.75" O.D.	KF 40

Foreline flange	KF16 NW
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Rotational speed	81000 rpm (1350 Hz driving frequency)
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Start-up time	< 2 minutes
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Recommended forepump	mechanical:	Agilent DS 42 / DS 102
	dry pump:	Agilent SH 110 / IDP-3

Operating position	Any
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Operating ambient temperature	+5 °C to +35 °C
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Relative humidity of air	0 - 90 % (not condensing)
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Bakeout temperature	80°C for ISO (120°C for CFF) at inlet flange
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Lubricant	Permanent lubrication
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### Cooling requirements

- Air Cooling	Air flow temperature +5°C to +35 °C
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- Water Cooling	Cooling water temperature: +15 °C to +25 °C
	Minimum flow: 65 l/h (0.30 GPM)
	Pressure: 2 to 4 bar (45 to 75 psi)

### Noise Pressure Level (at 1 mt at full speed)

	40 dB(A) *
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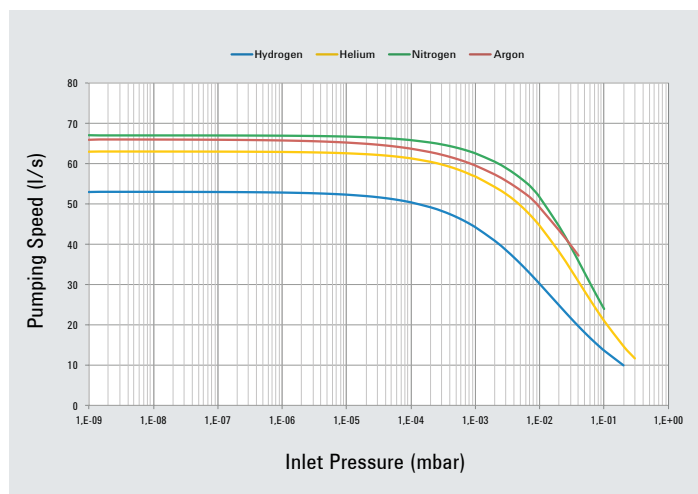
Storage temperature	-40° C to +70° C
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Max altitude	3000 m
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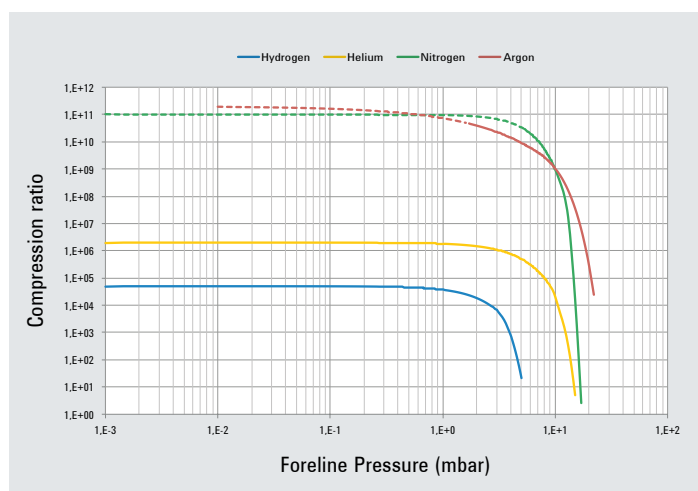
Weight kg (lbs)	Pump ISO 63	kg 2.05
	Pump CFF 4.5"	kg 3.50
	Pump CFF 2.75"	kg 3.34
	Pump KF 40"	kg 2.37

\*average value  $\pm$  4 dB(A) std deviation

## Pumping Speed



## Compression Ratio



## Ordering Information

Pumps	Part Numbers
TwisTorr 84FS ISO63	X3502-64000
TwisTorr 84FS KF40	X3502-64001
TwisTorr 84FS CFF4.5	X3502-64002
TwisTorr 84FS CFF2.75	X3502-64003

Controllers	Part Numbers
TwisTorr 84FS AG Rack controller RS232/485	X3508-64001
TwisTorr 84FS AG Rack controller Profibus	X3508-64002
TwisTorr 84FS on-board controller 110/220V	X3509-64000
TwisTorr 84FS on-board controller 24V	X3509-64001
TwisTorr 84FS PCB Controller	X3510-64000

Accessories	Part Numbers
<b>Cables</b>	
Mains cable NEMA plug, 3 m long	969-9958
Mains cable European plug, 3 m long	969-9957
Serial cable and T-plus software	969-9883
PCB cable	969-9869
Pump extension cable (3 m)	969-9942
Extension cable 5 m	969-9942M007
Extension cable 10 m	969-9942M006
Extension cable 15 m	969-9942M005
Extension cable 20 m	969-9942M004

<b>Inlet screen</b>	
Inlet screen ISO63	X3502-68001
Inlet screen CFF4.5"	X3502-68000
Inlet screen, KF40	969-9309
Inlet screen CFF 2.75"	969-9328

<b>Cooling</b>	
Metal Water Cooling Kit	X3502-68002
Plastic Water cooling kit	X3502-68003

Air cooling kit (0,5 m cable)	969-9290
Air cooling kit extension cable (5 m)	969-9940

<b>Vibration isolator</b>	
Vibration isolator ISO 63	969-9375
Vibration isolator CFF 4.5"	969-9376

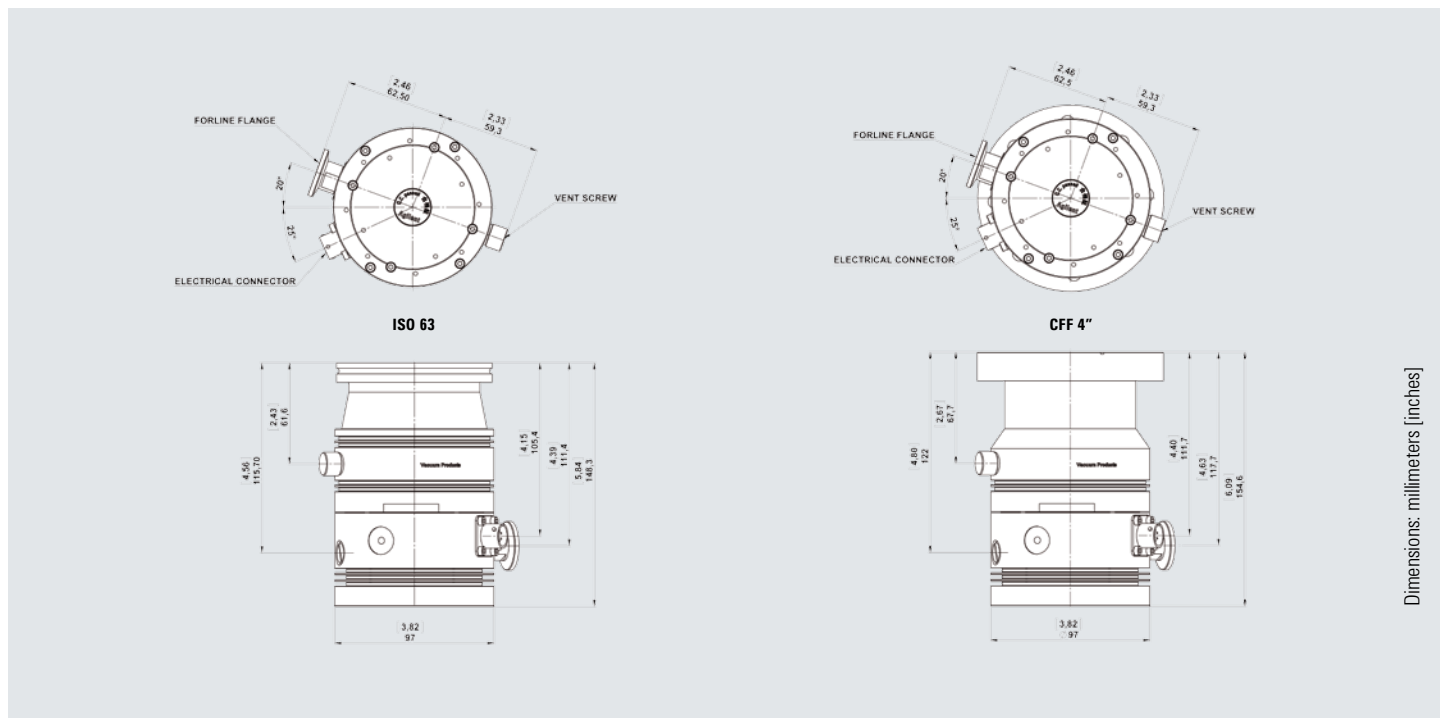
<b>Venting</b>	
Vent Valve N.O. 0,5 mm orifice (0,5 m cable)	969-9844
Vent Valve extension cable (5 m)	969-9941
Vent Valve extension cable (10 m)	969-9941M003
Vent Valve extension cable (15 m)	969-9941M001
Vent Valve extension cable (20 m)	969-9941M005
Vent Screw M5	X3502-68005
Vent Adapter kit M5-M8	X1699-64039

<b>Purge</b>	
Purge Screw	X3502-68004
Purge valve 10 SCCM NW16KF - M12	969-9239
Purge valve 10 SCCM ¼ Swagelok - M12	969-9240
Purge valve 20 SCCM NW16KF - M12	969-9241
Purge valve 20 SCCM ¼ Swagelok - M12	969-9242
Purge valve 10 SCCM ¼ Swagelok - ¼ Swagelok	969-9232
Purge valve 20 SCCM ¼ Swagelok - ¼ Swagelok	969-9236

<b>Mounting</b>	
Controller side mounting bracket	X3502-68006
CFF4.5 Mounting kit	X3502-68007
Metric screws kit	X3502-68008
American screws kit	X3502-68009

<b>Active Gauges</b>	
FRG 700 Full Range Gauge	Ask Agilent for details
PVG 500 Pirani Vacuum Gauge	Ask Agilent for details
PCG 750 Pirani Capacitance Gauge	Ask Agilent for details
CDG-500 Capacitance Diaphragm Gauge	Ask Agilent for details

## Outline Drawing



# Agilent TwisTorr 304 FS

## Technical Specifications

Pumping speed	ISO 100 / CF 6"	ISO 160 / CF 8"
N <sub>2</sub>	250 l/s	250 l/s
He	255 l/s	255 l/s
H <sub>2</sub>	220 l/s	220 l/s
Ar	250 l/s	250 l/s

Gas throughput at full rotational speed (with recommended forepump)	Ambient Temp. (25°C)	Water Temp. (25°C, 50 l/h)
N <sub>2</sub>	170 sccm	170 sccm
Ar	110 sccm	110 sccm

Compression ratio & Foreline Tolerance		
N <sub>2</sub>	$> 1 \times 10^{11}$	$> 10$ mbar
He	$> 1 \times 10^8$	$> 10$ mbar
H <sub>2</sub>	$1.5 \times 10^6$	$> 4$ mbar
Ar	$> 1 \times 10^{11}$	$> 10$ mbar

Base pressure with recommended forepump (5 m <sup>3</sup> /h)	
	$< 1 \times 10^{-10}$ mbar ( $< 1 \times 10^{-10}$ Torr)

Inlet flange	CFF 8" O.D. ISO 160 CFF 6" O.D. ISO 100
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Foreline flange	KF16 NW (KF25 - optional)
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Rotational speed	60000 rpm (1010 Hz driving frequency)
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Start-up time	< 3 minutes
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Recommended forepump	mechanical: Agilent DS 102 dry pump: Agilent SH 110
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Operating position	Any
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Operating ambient temperature	+5 °C to +35 °C
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Relative humidity of air	0 - 90 % (not condensing)
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Bakeout temperature	80 °C at inlet flange max (ISO flange) 120 °C at inlet flange max (CFF flange)
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Lubricant	Permanent lubrication
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Cooling requirements	Forced air (5- 35 °C ambient temperature) Water (mandatory if ambient temperature > 35 °C)
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Coolant water	Minimum flow: 50 l/h (0.89 GPM) Temperature: +15 °C to +30 °C Pressure: 3 to 5 bar (45 to 75 psi)
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Noise Pressure level	< 50 dB(A) at 1 meter
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Storage temperature	-40° C to +70° C
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Max altitude	3000 m
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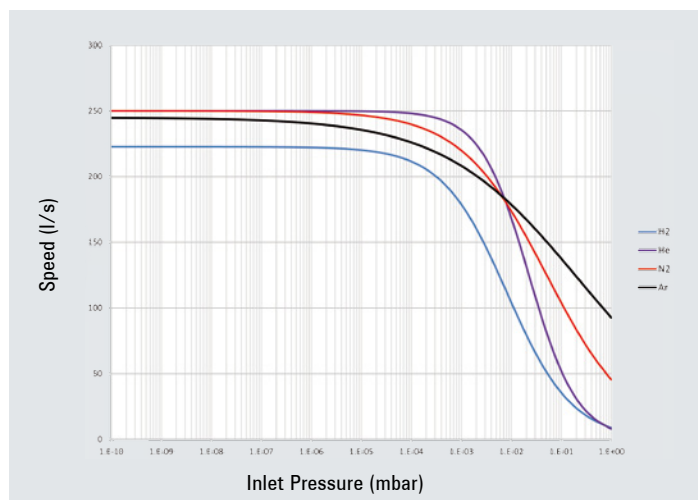
Weight kg (lbs)	Pump ISO 100 5.5 kg (12.3) Pump CFF 6" 7.5 kg (16.5) Pump ISO 160 5.7 kg (12.6) Pump CFF 8" 9.7 kg (20.9)
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## Conformity to norms

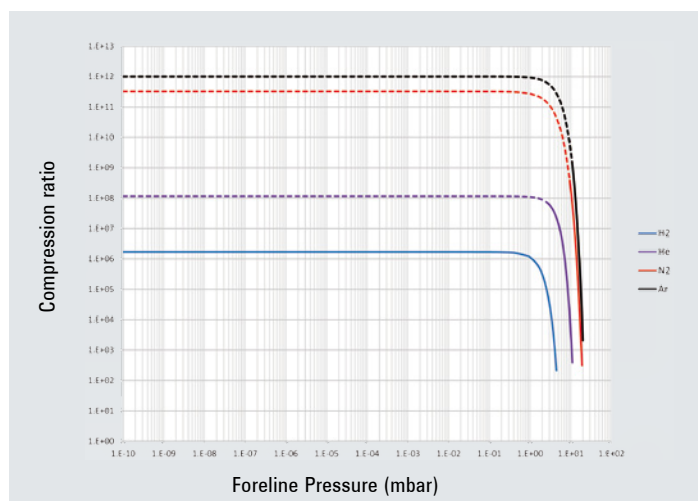
EMC	61326-1
Safety (CE/CSA) Regulatory	DIR 2006/42/CE
ROHS	DIR 2011/65/EU



## Pumping Speed



## Compression Ratio





## Ordering Information

Pumps	Configuration Options
TwisTorr 304 FS ISO100 water cooling	X3500-64000
TwisTorr 304 FS CFF 6" water cooling	X3500-64001
TwisTorr 304 FS ISO160 water cooling	X3500-64002
TwisTorr 304 FS CFF 8" water cooling	X3500-64003
TwisTorr 304 FS ISO100 air cooling	X3500-64004
TwisTorr 304 FS CFF 6" air cooling	X3500-64005
TwisTorr 304 FS ISO160 air cooling	X3500-64006
TwisTorr 304 FS CFF 8" air cooling	X3500-64007
TwisTorr 304 FS ISO100 SF water cooling	X3500-64010

Controllers	Part Numbers
TwisTorr 304 FS AG rack controller with RS232/485	X3506-64002
TwisTorr 304 FS AG rack controller with Profibus	X3506-64003
TwisTorr 304 FS on board controller 24 Vdc	X3507-64002
TwisTorr 304 FS on board controller 100-240 Vac	X3507-64003

Accessories	Part Numbers
<b>Cables</b>	
Mains cable NEMA plug, 3 m long	9699958
Mains cable European plug, 3 m long	9699957
Serial cable and T-plus Software	9699883
Extension cable 5 m	969-9942M007
Extension cable 10 m	969-9942M006
Extension cable 15 m	969-9942M005
Extension cable 20 m	969-9942M004

<b>Inlet Screen</b>	
Inlet Screen ISO100	X3500-68000
Inlet Screen CFF 6"	9699302
Inlet Screen ISO160	X3500-68001
Inlet Screen CFF 8"	9699304

<b>Cooling</b>	
Water cooling kit	9699337
Plastic water cooling kit	9699347

Air cooling kit for On board controller	X3500-68010
Fan extension cable for On board controller	9699949
Air cooling kit for rack AG controller	X3500-68011
Fan extension cable for rack AG controller	9699940

<b>Vibration isolator</b>	
Vibration isolator ISO 100	9699344
Vibration isolator CF 6"	9699334
Vibration isolator ISO 160	9699345
Vibration isolator CF 8"	9699335
Vibration isolator ISO 100 IDX	9699396
Vent flange, NW 10 KF / M8	9699108

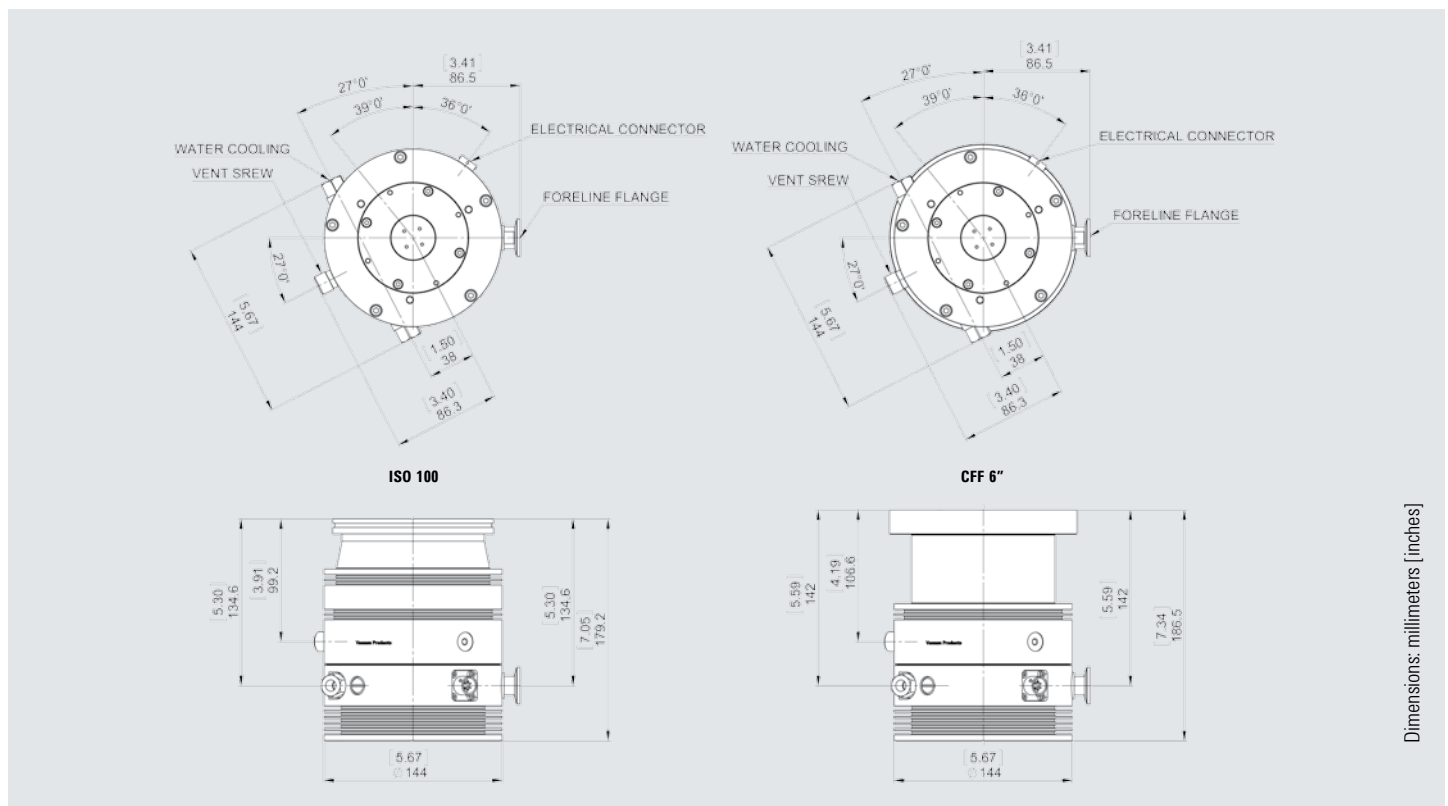
<b>Venting</b>	
Delay vent valve 1.2 mm orifice	X3505-68000
Delay vent valve 0.5 mm orifice	X3505-68001
Vent valve N.O. for rack AG controller (0.5 mm)	9699844
Vent valve for on-board controller (1.2 mm)	9699834
Vent valve for on-board controller (0.5 mm)	9699834M006

<b>Purge</b>	
Purge valve 10 SCCM NW16KF - M12	9699239
Purge valve 10 SCCM ¼ Swagelok - M12	9699240
Purge valve 20 SCCM NW16KF - M12	9699241
Purge valve 20 SCCM ¼ Swagelok - M12	9699242
Purge valve 10 SCCM ¼ Swagelok - ¼ Swagelok	9699232
Purge valve 20 SCCM ¼ Swagelok - ¼ Swagelok	9699236

<b>Mounting</b>	
Bracket for On board controller side mounting	X3500-68012
Foreline flange KF25	X3500-68002

<b>Active Gauges</b>	
FRG 700 Full Range Gauge	Ask Agilent for details
PVG 500 Pirani Vacuum Gauge	Ask Agilent for details
PCG 750 Pirani Capacitance Gauge	Ask Agilent for details
CDG-500 Capacitance Diaphragm Gauge	Ask Agilent for details

## Outline Drawing



Dimensions: millimeters [inches]

# Agilent TwisTorr 84 FS and 304 FS

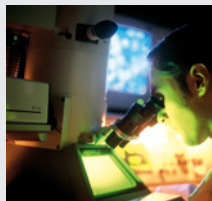
The new generation Turbo Pump platform:  
your solution for high performance, quality and reliability

## Applications

The new TwisTorr FS technology represents a unique blend of performance and features that is perfectly suited for a wide range of applications:



Unmatched vacuum performance in its class, with TwisTorr stages optimized for H<sub>2</sub> compression, make it the ideal solution for demanding academic and research applications



Thanks to low vibration, low noise and high stability, the TwisTorr FS turbo pumps meet the specific needs of Electron Microscopes



High throughput and optimized performance for light gases in routine applications are suited perfectly to use in analytical instruments



The TwisTorr FS turbo pumps offer dry, clean vacuum for demanding industrial and semiconductor applications

## Key Innovations

- TwisTorr Molecular Drag Turbo pump technology
- Optimized clearances design (radial and axial)
- Optimized thermal design
- Agilent Floating Suspension
- Optimized bearings size
- Noise <40 dB(A) at normal speed (TwisTorr 84 FS)
- Vibration stability over time
- Precise positioning of bearings and rotor



# Service & Support

To keep you up and running



## Advance Exchange

Premium Advance Exchange reduces your downtime and allows you to focus on your business success, while we take care of all the rest.

To maximize uptime and for time critical situations, Agilent offers Exchange units that are available for immediate shipment. These units are refurbished pumps and fully rebuilt to the same strict standards as new products with 24hrs response, rapid delivery and minimal downtime.

## Upgrade Program

Designed for customers who want to replace an Agilent product, at the end of its service life with a model of the latest available technology.

Within the upgrade program products rebuilt to as-new specifications are offered with a full 12-month warranty.

## Return to Agilent for Repair

With this service, you can ship your instrument to the nearest Agilent Service Center, where it is expertly repaired and then returned to you. Timely repair by Agilent will keep your product performance at an outstanding level all the time. Our specialized repair centers bring Agilent Quality Standards closer to you with fast turnaround time, Original parts and Certified Workmanship.



## Three Progressive Levels of Support

Agilent offers three convenient Service Programs to help you maximize your full stop at end.

Agilent Certified  
Rotary Vane  
Local field service  
Coverage  
Turbo Pumps  
Leak Detectors  
Exchange  
Quality  
Premium Service  
Dry Scroll Pumps  
Flexibility  
Speed  
Original parts  
Contracts  
Upgrade  
Repair  
Installed base

# Agilent TwisTorr FS Turbo Pumps

## Agilent Quality Assured

### Agilent Technologies

#### United States

Agilent Technologies  
121 Hartwell Avenue,  
Lexington MA 02421, USA  
Tel: +1 781 861 7200  
Fax: +1 781 860 5437  
Toll free: +1 800 882 7426  
vpl-customerservice@agilent.com

#### China

##### Beijing Office

Agilent Technologies (China) Co. Ltd  
No.3, Wang Jing Bei Lu, Chao Yang District,  
Beijing, 100102, China  
Tel: +86 (0)10 6439 7888  
Fax: +86 (0)10 6439 2765  
Toll free: 800 820 3278  
vacuum.cnmarketing@agilent.com  
vpc-customerservice@agilent.com

##### Shanghai Office

Agilent Technologies  
16F Shanghai Litong Plaza,  
No.1350 North Si Chuan Road,  
Hongkou District,  
Shanghai, 200080, China  
Tel: +86 (0)21 3612 7688  
Fax: +86 (0)21 6628 5169  
Toll free: 800 820 3278

##### Guangzhou Office

Agilent Technologies  
Unit 08, 66/F, Citic Plaza,  
233 Tian He Bei Rd  
Guangzhou, 510613, China  
Tel: +86 (0)20 38113988  
Fax: +86 (0)20 86695861  
Toll free: 800 820 3278

#### Shenzhen Office

Agilent Technologies  
3/F Dutyfree Business Bldg.,  
No.6, 1st Fu Hua Road, Futian CBD  
Shenzhen, 518048  
Tel: +86 (0)755 8307 9589  
Fax: +86 (0)755 8276 3182  
Toll free: 800 820 3278

#### Brazil

Agilent Technologies Brasil  
Avenida Marcos Pentead de Ulhoa  
Rodrigues, 939 - 6° andar  
Castelo Branco Office Park  
Torre Jacarandá - Tamboré  
Barueri, Sao Paulo CEP: 06460-040  
Toll free: 0800 728 1405

#### Benelux

Agilent Technologies Netherlands BV  
Groenelaan 5, 1186 AA Amstelveen  
The Netherlands  
Tel: +31 20 547 2000  
Fax: +31 20 547 2093

#### France

Agilent Technologies  
Parc Technopolis - Z.A. de Courtaboeuf  
3, avenue du Canada - CS 90263  
91978 Les Ulis cedex, France  
Tel: +33 (0) 1 64 53 61 15  
Fax: +33 (0) 1 64 53 50 01  
vpf.sales@agilent.com

#### Germany and Austria

Agilent Technologies  
Sales & Services GmbH & Co. KG  
Lyoner Str. 20  
60 528 Frankfurt am Main, Germany  
Tel: +49 69 6773 43 2230  
Fax: +49 69 6773 43 2250

#### India

Agilent Technologies India Pvt Ltd  
Unit Nos 105-116  
First Floor, Splendor Forum,  
Plot No.-3, District Centre, Jasola  
New Delhi-110025  
Ph: +91 11 4623 7100  
Fax: +91 4623 7105  
Toll Free: 18001801517

#### Italy

Agilent Technologies Italia SpA  
via F.lli Varian 54  
10040 Leini (Torino), Italy  
Tel: +39 011 9979 111  
Fax: +39 011 9979 350  
Toll free: 00 800 234 234 00  
vpt-customerservice@agilent.com

#### Japan

Agilent Technologies Japan, Ltd.  
8th Floor Sumitomo Shibaura Building  
4-16-36 Shibaura Minato-ku  
Tokyo 108-0023, Japan  
Tel: +81 3 5232 1253  
Fax: +81 3 5232 1710  
Toll free: 0120 655 040  
vpj-customerservice@agilent.com

#### Korea

Agilent Technologies Korea Ltd.  
Shinsa 2nd Bldg. 1F, 966-5 Daechi-dong  
Kangnam-gu, Seoul, Korea 135-280  
Tel: +82 (0)2 2194 9449  
Fax: +82 (0)2 3452 3947  
Toll free: 080 222 2452  
vpk-customerservice@agilent.com

#### Mexico

Agilent Technologies  
Concepcion Beistegui No 109  
Col Del Valle, C.P. 03100, Mexico, D.F.  
Tel: +52 5 523 9465  
Fax: +52 5 523 9472

#### Singapore

Agilent Technologies Singapore Pte Ltd.  
No.1 Yishun Avenue 7, Singapore 768923  
Tel: +65 6215 8045  
Fax: +65 6754 0574  
Toll free: 1 800 2762622  
vps-customerservice@agilent.com

#### Southeast Asia

Agilent Technologies Sales Sdn Bhd  
Unit 201, Level 2 uptown 2,  
2 Jalan SS21/37, Damansara Uptown  
47400 Petaling Jaya, Selangor, Malaysia  
Tel: +60 3 7712 6106  
Fax: +60 3 6733 8121  
Toll free: 1 800 880 805  
vps-customerservice@agilent.com

#### Taiwan

Agilent Technologies Taiwan Limited  
20 Kao-Shuang Road Ping-Chen City  
Tao-Yuan Hsien,  
32450 Taiwan, R.O.C.  
Tel: +886 3 4959004  
Fax: +886 3 4924628  
Toll free: 0800 018 768  
vpw-customerservice@agilent.com

#### UK and Ireland

Agilent Technologies UK Ltd.  
6 Mead Road, Oxford Industrial Park  
Yarnton, Oxford OX5 1QU, UK  
Tel: +44 (0) 1865 291570  
Fax: +44 (0) 1865 291571



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