DC–20 GHz GaAs MMIC SP2T Non-Reflective Switch
MMS006AA

MICROCHIP

Product Overview

The MMS006AA device is a DC-to-20 GHz, non-reflective gallium arsenide (GaAs) pseudomorphic high-electron mobility transistor (pHEMT), high isolation single pole double throw (SPDT) monolithic microwave integrated circuit (MMIC) chip.

The switch delivers over 40 dB of isolation across the entire DC-to-20 GHz frequency range, while maintaining a low insertion loss of less than 2 dB. The MMS006AA device operates using two negative control voltage logic lines of –5V and 0V, respectively. It requires no VEE, and consumes essentially zero current. The RF ports are internally matched to 50Ω, which allows for easy integration into multi-chip modules (MCMs).

Key Features

- Wide operating range: DC–20 GHz
- Low insertion loss: <2 dB
- High input P1dB: 24 dBm
- Excellent isolation: >40 dB
- High input IP3: 42 dBm
- Fast switching: <10 ns
- Non-reflective topology
- Compact die size: 0.85 mm × 1.30 mm × 0.1 mm

Functional Block Diagram
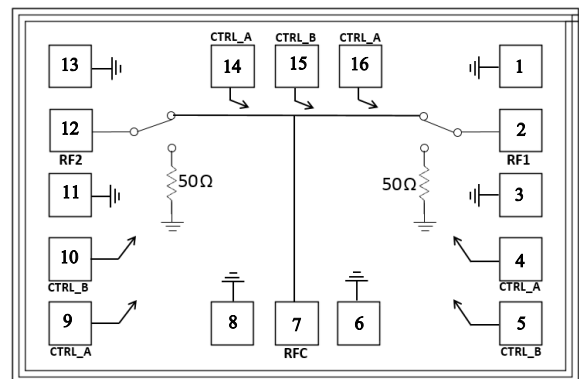
Applications

- Test instrumentation
- Military radar, radio, EW, and ECM applications
- General purpose microwave applications

Table 1. Performance Overview

Parameter	Typ	Units
Input frequency	DC–20	GHz
Insertion loss	<2	dB
Isolation	< –40	dB
Input P1dB	24	dBm

Export Classification: EAR99

Insertion Loss

Table of Contents

1. Electrical Specifications

1.1 Typical Electrical Performance

Table 1-1. Typical Electrical Performance at 25 °C, Vcontrol = 0V / − 5V (Unless otherwise mentioned).

Parameter	Test Conditions	Min	Typ.	Max	Units
Frequency range		DC		20	GHz
Insertionl oss (all states)	DC–20 GHz			2.0	dB
Isolation loss (all states)	DC–20 GHz	−40			dB
Input P1dB	DC–20 GHz			24	dBm
Input IP3	DC–20 GHz (2-tones, 7 dBm per tone)			42	dBm
T_{RISE}, T_{FALL}	DC–20 GHz (10% to 90% and 90% to 10% RF)			10	ns
T_{ON}, T_{OFF}	DC–20 GHz (50% control to 90% RF, and 50% control to 90% RF)		10		ns
Return loss (all states)	DC–20 GHz		−15		dB
Control voltage	Low	−3.0		0	V
	High	−5.0		−4.2	V

1.2 Typical Performance Curves

The following graphs show the typical performance curves of the MMS006AA device at +25 °C, 0 /–5V control voltage (Unless otherwise indicated).
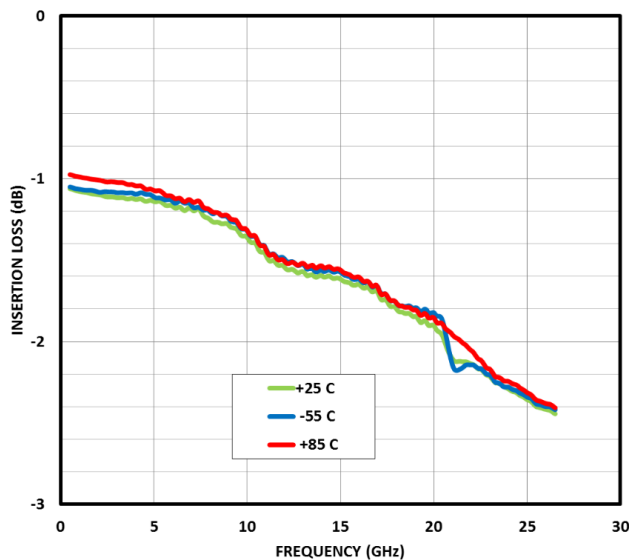
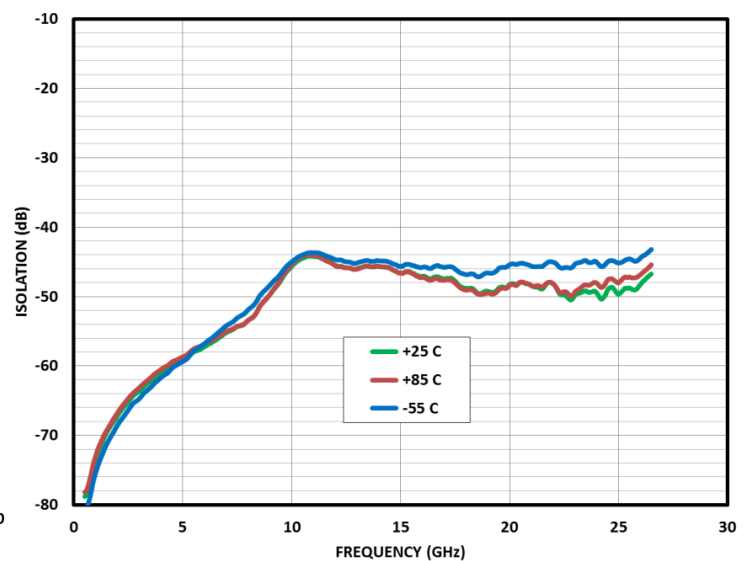**Figure 1-1.** Insertion Loss

Figure 1-2. Isolation
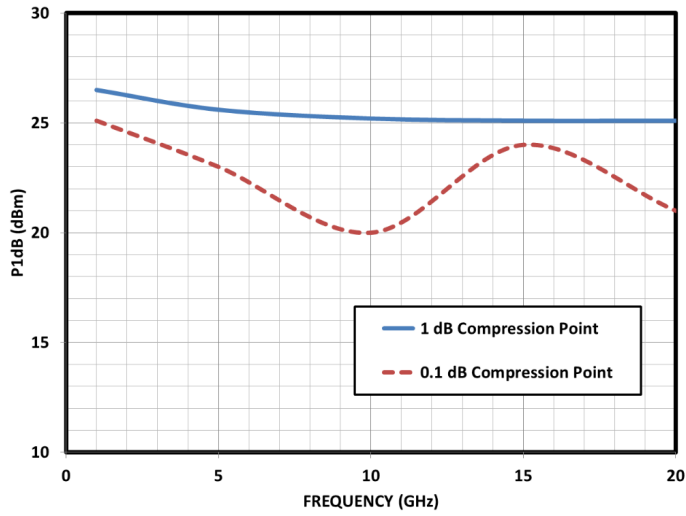
Figure 1-3. Compression
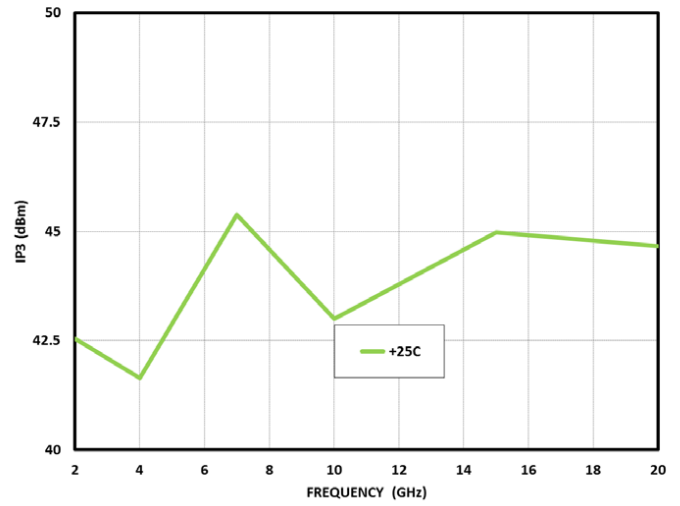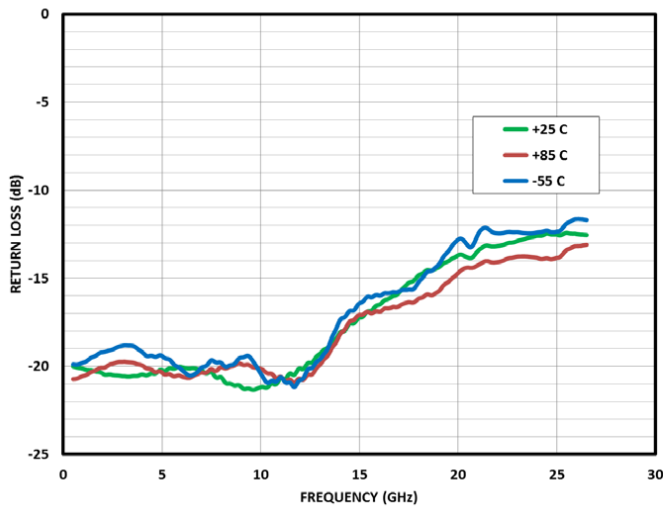
Figure 1-4. Input IP3

Figure 1-5. Return Loss

1.3   Absolute Maximum Ratings

The following table shows the absolute maximum ratings of the MMS006AA device at 25 °C, unless otherwise specified. Exceeding one or any of the maximum ratings potentially could cause damage or latent defects to the device.

Table 1-2. Absolute Maximum Ratings

Parameter	Rating
Control voltage range (A/B)	+0.5V to –7.5V
Max RF input power	30 dBm
Hot switching power	27 dBm
Channel temperature	150 °C
Thermal resistance	18 °C/W
Operating temperature	–40 °C to +85 °C
Storage temperature	–65 °C to +150 °C
ESD HBM	Class 1A

ESD Sensitive Device

2. Die Specifications

The following illustration shows the chip outline of the MMS006AA device. Dimensions are shown in inches and millimeters. The minimum bond pad size is 100 µm × 100 µm. Both the bond pad surface and the backside metal are 3 µm gold. The die thickness is 100 µm. The backside is the DC/RF ground. The airbridge keepout region is in crosshatch, and the unlabeled pads should not be bonded.

For additional packaging information, contact your Microchip sales representative.

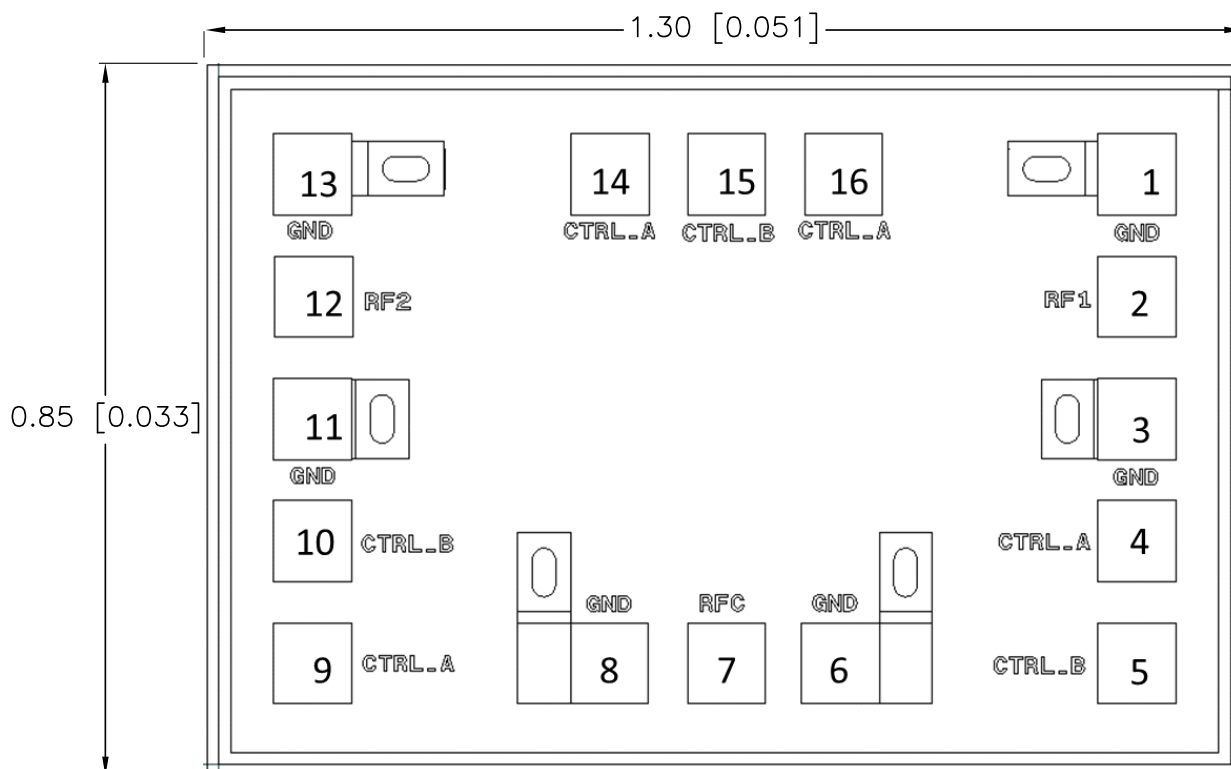**Figure 2-1.** Die Outline Drawing mm[inches]

Table 2-1. I/O Pad Description

Pad Number	Pad Label	Description	Notes
7	RFC	RF common. DC coupled	Depending on switch state, a small (< 200 mV) DC voltage leaks to this pad.
2 & 12	RF1 & RF2	RF output 1 and RF Output 2. DC-coupled	Depending on switch state, a small (< 200 mV) DC voltage leaks to this pad.
4, 9, 14, 16	CTRL-A	DC control voltage	All CTRL-A Pads are connected together on chip.
5, 10, 15	CTRL-B	DC control voltage	All CTRL-B Pads are connected together on chip.
1, 3, 6, 8, 11, 13	GND	RF/DC ground	On chip connected to DC/RF GND
	Die backside	RF/DC ground	On chip connected to DC/RF GND

Table 2-2. Truth Table

Control Input		Signal Path	
A	**B**	**RFC to RF1**	**RFC to RF2**
High	Low	On	Off
Low	High	Off	On
High	High	Undefined	Undefined
Low	Low	Undefined	Undefined

Table 2-3. Control Voltage

State	Bias Condition
Low	–3V to 0V
High	–5.0V to –4.2V

3. Application Ciruits

The following illustration shows the assembly diagram of the MMS006AA device. Attach components using thermally conductive epoxy.

Figure 3-1. Assembly Diagram
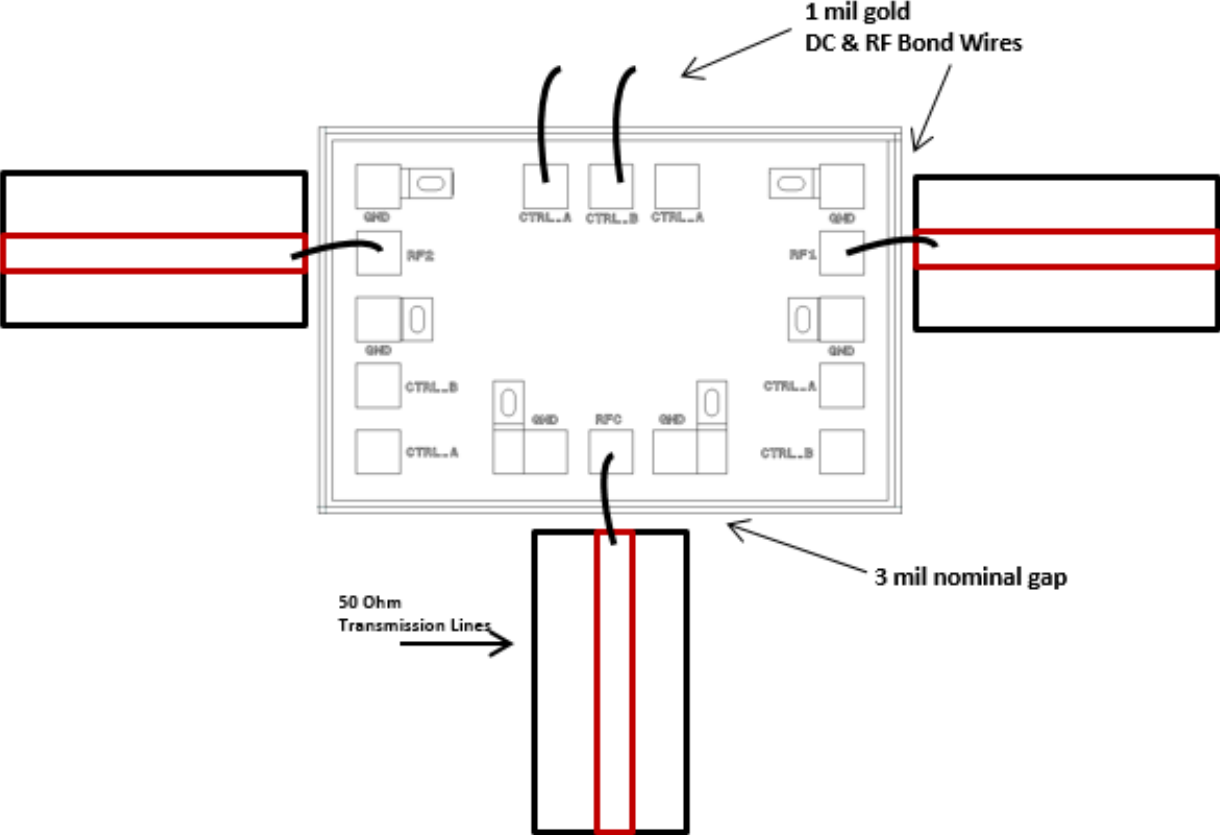
4. Ordering, Shipping, and Handling

4.1 Handling Recommendations

Gallium arsenide integrated circuits are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. It is recommended to follow all procedures and guidelines outlined in the Microsemi application note AN01: GaAs MMIC Handling and Die Attach Recommendations.

4.2 Ordering Information

For additional ordering information, contact your Microchip sales representative.

Part Number	Package	Note
MMS006AA	Die	
MMS006PP3	3 mm × 3 mm, 16L Plastic QFN	Refer to corresponding Datasheet

4.3 Packing Information

Standard Format	Optional Format
Waffle Pack	Gel Pack

Note: Contact your Microchip sales representative for the minimum quantity order

MICROCHIP

5.   Revision History

The revision history describes the changes that were implemented in the document. The changes are listed by revision, starting with the most current publication.

Table 5-1. Revision History

Revision	Date	Description
A	07/2022	Document migrated from Microsemi template to Microchip template; Assigned Microchip literature number DS-00004635A.
Initial release (Microsemi Revision A)	2016	Document created.

Microchip Information

The Microchip Website

Microchip provides online support via our website at www.microchip.com/. This website is used to make files and information easily available to customers. Some of the content available includes:

- **Product Support** – Data sheets and errata, application notes and sample programs, design resources, user's guides and hardware support documents, latest software releases and archived software
- **General Technical Support** – Frequently Asked Questions (FAQs), technical support requests, online discussion groups, Microchip design partner program member listing
- **Business of Microchip** – Product selector and ordering guides, latest Microchip press releases, listing of seminars and events, listings of Microchip sales offices, distributors and factory representatives

Product Change Notification Service

Microchip's product change notification service helps keep customers current on Microchip products. Subscribers will receive email notification whenever there are changes, updates, revisions or errata related to a specified product family or development tool of interest.

To register, go to www.microchip.com/pcn and follow the registration instructions.

Customer Support

Users of Microchip products can receive assistance through several channels:

- Distributor or Representative
- Local Sales Office
- Embedded Solutions Engineer (ESE)
- Technical Support

Customers should contact their distributor, representative or ESE for support. Local sales offices are also available to help customers. A listing of sales offices and locations is included in this document.

Technical support is available through the website at: www.microchip.com/support

Microchip Devices Code Protection Feature

Note the following details of the code protection feature on Microchip products:

- Microchip products meet the specifications contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is secure when used in the intended manner, within operating specifications, and under normal conditions.
- Microchip values and aggressively protects its intellectual property rights. Attempts to breach the code protection features of Microchip product is strictly prohibited and may violate the Digital Millennium Copyright Act.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of its code. Code protection does not mean that we are guaranteeing the product is "unbreakable". Code protection is constantly evolving. Microchip is committed to continuously improving the code protection features of our products.

Legal Notice

This publication and the information herein may be used only with Microchip products, including to design, test, and integrate Microchip products with your application. Use of this information in any other manner violates these terms. Information regarding device applications is provided only for your convenience and may be superseded by updates. It is your responsibility to ensure

MICROCHIP

that your application meets with your specifications. Contact your local Microchip sales office for additional support or, obtain additional support at www.microchip.com/en-us/support/design-help/client-support-services.

Trademarks

Quality Management System

For information regarding Microchip's Quality Management Systems, please visit www.microchip.com/quality.

Worldwide Sales and Service

AMERICAS	ASIA/PACIFIC	ASIA/PACIFIC	EUROPE
Corporate Office 2355 West Chandler Blvd. Chandler, AZ 85224-6199 Tel: 480-792-7200 Fax: 480-792-7277 Technical Support: www.microchip.com/support Web Address: www.microchip.com	**Australia - Sydney** Tel: 61-2-9868-6733 **China - Beijing** Tel: 86-10-8569-7000 **China - Chengdu** Tel: 86-28-8665-5511 **China - Chongqing** Tel: 86-23-8980-9588 **China - Dongguan** Tel: 86-769-8702-9880	**India - Bangalore** Tel: 91-80-3090-4444 **India - New Delhi** Tel: 91-11-4160-8631 **India - Pune** Tel: 91-20-4121-0141 **Japan - Osaka** Tel: 81-6-6152-7160 **Japan - Tokyo** Tel: 81-3-6880- 3770	**Austria - Wels** Tel: 43-7242-2244-39 Fax: 43-7242-2244-393 **Denmark - Copenhagen** Tel: 45-4485-5910 Fax: 45-4485-2829 **Finland - Espoo** Tel: 358-9-4520-820 **France - Paris** Tel: 33-1-69-53-63-20
Atlanta Duluth, GA Tel: 678-957-9614 Fax: 678-957-1455	**China - Guangzhou** Tel: 86-20-8755-8029 **China - Hangzhou** Tel: 86-571-8792-8115	**Korea - Daegu** Tel: 82-53-744-4301 **Korea - Seoul** Tel: 82-2-554-7200	Fax: 33-1-69-30-90-79 **Germany - Garching** Tel: 49-8931-9700 **Germany - Haan**
Austin, TX Tel: 512-257-3370	**China - Hong Kong SAR** Tel: 852-2943-5100	**Malaysia - Kuala Lumpur** Tel: 60-3-7651-7906	Tel: 49-2129-3766400 **Germany - Heilbronn**
Boston Westborough, MA Tel: 774-760-0087 Fax: 774-760-0088	**China - Nanjing** Tel: 86-25-8473-2460 **China - Qingdao** Tel: 86-532-8502-7355	**Malaysia - Penang** Tel: 60-4-227-8870 **Philippines - Manila** Tel: 63-2-634-9065	Tel: 49-7131-72400 **Germany - Karlsruhe** Tel: 49-721-625370 **Germany - Munich**
Chicago Itasca, IL Tel: 630-285-0071 Fax: 630-285-0075	**China - Shanghai** Tel: 86-21-3326-8000 **China - Shenyang** Tel: 86-24-2334-2829	**Singapore** Tel: 65-6334-8870 **Taiwan - Hsin Chu** Tel: 886-3-577-8366	Tel: 49-89-627-144-0 Fax: 49-89-627-144-44 **Germany - Rosenheim** Tel: 49-8031-354-560
Dallas Addison, TX Tel: 972-818-7423 Fax: 972-818-2924	**China - Shenzhen** Tel: 86-755-8864-2200 **China - Suzhou** Tel: 86-186-6233-1526	**Taiwan - Kaohsiung** Tel: 886-7-213-7830 **Taiwan - Taipei** Tel: 886-2-2508-8600	**Israel - Ra'anana** Tel: 972-9-744-7705 **Italy - Milan** Tel: 39-0331-742611
Detroit Novi, MI Tel: 248-848-4000	**China - Wuhan** Tel: 86-27-5980-5300 **China - Xian**	**Thailand - Bangkok** Tel: 66-2-694-1351 **Vietnam - Ho Chi Minh**	Fax: 39-0331-466781 **Italy - Padova** Tel: 39-049-7625286
Houston, TX Tel: 281-894-5983	Tel: 86-29-8833-7252 **China - Xiamen**	Tel: 84-28-5448-2100	**Netherlands - Drunen** Tel: 31-416-690399
Indianapolis Noblesville, IN Tel: 317-773-8323 Fax: 317-773-5453 Tel: 317-536-2380	Tel: 86-592-2388138 **China - Zhuhai** Tel: 86-756-3210040		Fax: 31-416-690340 **Norway - Trondheim** Tel: 47-72884388 **Poland - Warsaw** Tel: 48-22-3325737
Los Angeles Mission Viejo, CA Tel: 949-462-9523 Fax: 949-462-9608 Tel: 951-273-7800			**Romania - Bucharest** Tel: 40-21-407-87-50 **Spain - Madrid** Tel: 34-91-708-08-90 Fax: 34-91-708-08-91
Raleigh, NC Tel: 919-844-7510 **New York, NY** Tel: 631-435-6000			**Sweden - Gothenberg** Tel: 46-31-704-60-40 **Sweden - Stockholm** Tel: 46-8-5090-4654
San Jose, CA Tel: 408-735-9110 Tel: 408-436-4270			**UK - Wokingham** Tel: 44-118-921-5800 Fax: 44-118-921-5820
Canada - Toronto Tel: 905-695-1980 Fax: 905-695-2078			