



ATtiny87/167 Automotive

Automotive Silicon Errata and Data Sheet Clarifications

Introduction

The ATtiny87/167 Automotive devices you have received conform functionally to the current device data sheet (www.microchip.com/mymicrochip/filehandler.aspx?ddocname=en590544), except for the anomalies described in this document. The errata described in this document will likely be addressed in future revisions of the ATtiny87/167 Automotive devices.

Note:

- This document summarizes all the silicon errata issues from all revisions of silicon, previous and current.

1. Silicon Issue Summary

Legend

- Erratum is not applicable.
- X Erratum is applicable.

Errata Overview

Peripheral	Short Description	Valid for Silicon Revision		
		Rev. A	Rev. B	Rev. C
		Date Code > 1207	Date Code > 1208	
System Clock and Clock Options	2.2.1 Gain Control of the Crystal Oscillator	X	X	X
	2.2.2 "Disable Clock Source" Command Remains Enabled	X	X	X
LIN-UART	2.3.1 CRC Calculation of Diagnostic Frames in LIN 2.x	X	-	-
	2.3.2 LIN Break Delimiter	X	X	-
ADC	2.4.1 Comparison Between ADC Inputs and Voltage References	X	-	-
	2.4.2 Register Bits of DIDR1	X	-	-

2. Silicon Errata Issues

2.1 Errata Details

- Erratum is not applicable.
- X** Erratum is applicable.

2.2 System Clock and Clock Options

2.2.1 Gain Control of the Crystal Oscillator

The crystal oscillator (0.4 → 16 MHz) doesn't latch its gain control (CKSEL/CSEL[2..0] bits):

1. The 'recover system clock source' command doesn't return CSEL[2..0] bits.
2. The gain control can be modified on the fly if CLKSELR changes.

Work Around

1. No work around.
2. As soon as possible, after any CLKSELR modification, re-write the appropriate crystal oscillator setting (CSEL[3]=1 and CSEL[2..0] / CSUT[1..0] bits) in CLKSELR.

Code example:

```
; Select crystal oscillator (16MHz crystal, fast rising power)
ldi temp1, ((0x0F<<CSEL0) | (0x02<<CSUT0))
sts CLKSELR, temp1
; Enable clock source (crystal oscillator)
ldi temp2, (1<<CLKCCE)
ldi temp3, (0x02<<CLKC0) ; CSEL = "0010"
sts CLKCSR, temp2 ; Enable CLKCSR register access
sts CLKCSR, temp3 ; Enable crystal oscillator clock
; Clock source switch
ldi temp3, (0x04<<CLKC0) ; CSEL = "0100"
sts CLKCSR, temp2 ; Enable CLKCSR register access
sts CLKCSR, temp3 ; Clock source switch
; Select watchdog clock (128KHz, fast rising power)
ldi temp3, ((0x03<<CSEL0) | (0x02<<CSUT0))
sts CLKSELR, temp3 ; (*)
; (*) !!! Loose gain control of crystal oscillator !!!
; ==> WORKAROUND ...
sts CLKSELR, temp1
; ...
```

Affected Silicon Revisions

Rev. A	Rev. B	Rev. C
X	X	X

2.2.2 “Disable Clock Source” Command Remains Enabled

In the dynamic clock switch module, the 'disable clock source' command remains running after disabling the targeted clock source (the clock source is set in the CLKSELR register).

Work Around

After a 'disable clock source' command, reset the CLKCSR register by writing 0x80.

Code example:

```
; Select crystal oscillator
ldi temp1, (0x0F<<CSEL0)
sts CLKSELR, temp1
; Disable clock source (crystal oscillator)
ldi temp2, (1<<CLKCCE)
ldi temp3, (0x01<<CLKC0) ; CSEL = "0001"
sts CLKCSR, temp2 ; Enable CLKCSR register access
sts CLKCSR, temp3 ; (*) Disable crystal oscillator clock
; (*) !!! At this moment, if any other clock source is selected by CLKSELR,
; this clock source will also stop !!!
; ==> WORKAROUND ...
sts CLKCSR, temp2
```

Affected Silicon Revisions

Rev. A	Rev. B	Rev. C
X	X	X

2.3 LIN-UAT

2.3.1 CRC Calculation of Diagnostic Frames in LIN 2.x

Diagnostic frames of LIN 2.x use “classic checksum” calculation. Unfortunately, the setting of the checksum mode is enabled when the HEADER is transmitted/received. Usually, in LIN 2.x, the LIN/UART controller is initialized to process “enhanced checksums”. A slave task does not know what kind of frame it will work on before checking the ID.

Work Around

This work around is to be implemented only in the case of transmission/reception of diagnostic frames.

1. Slave task of master node: Before enabling the HEADER, the master must set the appropriate LIN13 bit value in the LINCR register.
2. For slave nodes, the work around is in two parts:
 - a. Before enabling the RESPONSE, use the following function:

```
void lin_wa_head(void) {
    unsigned char temp;
    temp = LINBTR;
    LINCR = 0x00; // It is not a RESET !
    LINBTR = (1<<LDISR) | temp;
    LINCR = (1<<LIN13) | (1<<LENA) | (0<<LCMD2) | (0<<LCMD1) | (0<<LCMD0);
    LINDLR = 0x88; // If it isn't already done
}
```

- b. Once the RESPONSE is received or sent (having RxOK or TxOK as well as LERR), use the following function:

```
void lin_wa_tail(void) {
    LINCR = 0x00; // It is not a RESET !
    LINBTR = 0x00;
    LINCR = (0<<LIN13) | (1<<LENA) | (0<<LCMD2) | (0<<LCMD1) | (0<<LCMD0);
}
```

The time-out counter is disabled during the RESPONSE when this work around is set.

Affected Silicon Revisions

Rev. A	Rev. B	Rev. C

X	-	-
---	---	---

2.3.2 LIN Break Delimiter

In SLAVE MODE, a BREAK field detection error can occur under the following conditions.

The problem occurs if two conditions occur simultaneously:

1. The DOMINANT part of the BREAK is $(N+0.5)*T_{bit}$ long with $N=13, 14, 15, \dots$
2. The RECESSIVE part of the BREAK (BREAK DELIMITER) is equal to $1*T_{bit}$. (See the note below).

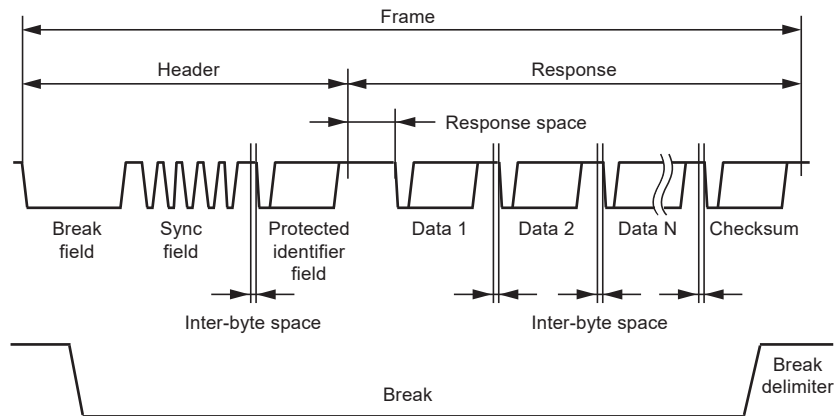
The BREAK_high is not detected, and the 2nd bit of the SYNC field is interpreted as the BREAK DELIMITER. The error is detected as a framing error on the first bits of the PID or subsequent Data or a Checksum error.

There is no error if BREAK_high is greater than $1 \times T_{bit} + 18\%$.

There is no problem in Master mode.

Note: LIN2.1 protocol specification paragraph 2.3.1.1 Break field says (www.microchip.com/mymicrochip/filehandler.aspx?ddocname=en590544): "A break field is always generated by the master task (in the master node) and it shall be at least 13 nominal bit times of dominant value, followed by a break delimiter, as shown in Figure 2-1. The break delimiter shall be at least one nominal bit time long."

Figure 2-1. The Break Field



Work Around

None

Affected Silicon Revisions

Rev. A	Rev. B	Rev. C
X	X	-

2.4 ADC

2.4.1 Comparison Between ADC Inputs and Voltage References

In the analog comparator module, comparing any ADC input (ADC[10..0]) with voltage references (2.56V, 1.28V, 1.10V, 0.64V or 0.32V) fails.

Regardless, AIN1 input can be compared with the voltage references, and any ADC input can be compared with the AIN0 input.

Work Around

Do not use this configuration.

Affected Silicon Revisions

Rev. A	Rev. B	Rev. C
X	-	-

2.4.2 Register Bits of DIDR1

ADC8D, ADC9D and ADC10D (digital input disable) initially located at bit 4 up to 6 are instead located at bit 0 up to 2. These register bits are also in write-only mode.

Work Around

Allow for the change in bit locations and the access mode restriction.

Affected Silicon Revisions

Rev. A	Rev. B	Rev. C
X	-	-

3. Data Sheet Clarifications

The following typographic corrections and clarifications are to be noted for the latest version of the device data sheet (www.microchip.com/mymicrochip/filehandler.aspx?ddocname=en590544).

Note: Corrections are shown in **bold**. Where possible, the original bold text formatting has been removed for clarity.

3.1 Errata Section in Data Sheet is no Longer Valid

A clarification for the Errata section in the device data sheet has been made.

The errata content has been moved to a separate document, *ATtiny87/167 Automotive Silicon Errata and Data Sheet Clarifications* (this document).

For the latest errata, see the *Silicon Errata Issues* section of this document.

3.2 Interrupts

3.2.1 Interrupt Vectors in ATtiny87/167 Automotive

A clarification for the source names of the Interrupt vectors has been made to comply with the header file naming convention.

Table 3-1. Reset and Interrupt Vectors in ATtiny87/167 Automotive

Vector Nb.	Program Address		Source	Interrupt Definition
	ATtiny87	ATtiny167		
1	0x0000	0x0000	RESET	External Pin, Power-on Reset, Brown-out Reset and Watchdog System Reset
2	0x0001	0x0002	INT0	External Interrupt Request 0
3	0x0002	0x0004	INT1	External Interrupt Request 1
4	0x0003	0x0006	PCINT0	Pin Change Interrupt Request 0
5	0x0004	0x0008	PCINT1	Pin Change Interrupt Request 1
6	0x0005	0x000A	WDT	Watchdog Time-out Interrupt
7	0x0006	0x000C	TIMER1_CAPT	Timer/Counter1 Capture Event
8	0x0007	0x000E	TIMER1_COMPA	Timer/Counter1 Compare Match A
9	0x0008	0x0010	TIMER1_COMPB	Timer/Counter1 Compare Match B
10	0x0009	0x0012	TIMER1_OVF	Timer/Counter1 Overflow
11	0x000A	0x0014	TIMER0_COMPA	Timer/Counter0 Compare Match A
12	0x000B	0x0016	TIMER0_OVF	Timer/Counter0 Overflow
13	0x000C	0x0018	LIN_TC	LIN/UART Transfer Complete
14	0x000D	0x001A	LIN_ERR	LIN/UART Error
15	0x000E	0x001C	SPI_STC	SPI Serial Transfer Complete
16	0x000F	0x001E	ADC	ADC Conversion Complete
17	0x0010	0x0020	EE_READY	EEPROM Ready
18	0x0011	0x0022	ANA_COMP	Analog Comparator

.....continued				
Vector Nb.	Program Address		Source	Interrupt Definition
	ATtiny87	ATtiny167		
19	0x0012	0x0024	USI_START	USI Start Condition Detection
20	0x0013	0x0026	USI_OVF	USI Counter Overflow

3.3 LIN/UART - Local Interconnect Network Controller or UART

3.3.1 Baud Rate Generator

A clarification has been made for the equations in the Baud Rate Generator section.

The baud rate is defined to be the transfer rate in bits per second (bps):

- BAUD: Baud rate (in bps)
- $f_{clk_{i/o}}$: System I/O clock frequency
- LDIV[11..0]: Contents of LINBRRH & LINBRRL registers - (0-4095), the pre-scaler receives $clk_{i/o}$ as input clock
- LBT[5..0]: Least significant bits of - LINBTR register- (0-63) is the number of samplings in a LIN or UART bit (default value 32)

Equation for calculating baud rate:

$$BAUD = f_{clk_{i/o}} / (LBT[5..0] \times (LDIV[11..0] + 1))$$

Equation for setting LINDIV value:

$$LDIV[11..0] = (f_{clk_{i/o}} / (LBT[5..0] \times BAUD)) - 1$$

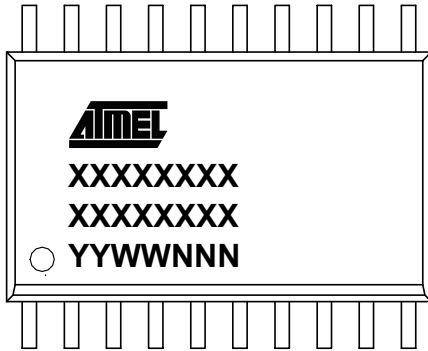
Note that in reception, a majority vote on three samplings is made.

3.4 Package Marking Information

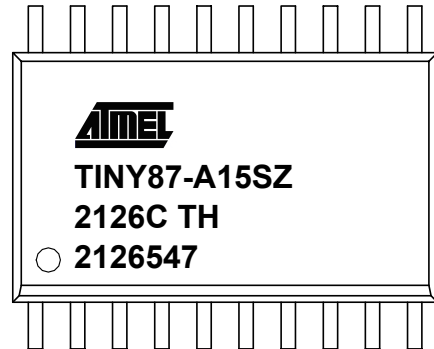
Legend:	XX...X	Customer-specific information or Microchip part number
	Y	Year code (last digit of calendar year)
	YY	Year code (last 2 digits of calendar year)
	WW	Week code (week of January 1 is week '01')
	NNN	Alphanumeric traceability code
	(e3)	Pb-free JEDEC [®] designator for Matte Tin (Sn)
Note:	In the event the full Microchip part number cannot be marked on one line, it will be carried over to the next line, thus limiting the number of available characters for customer-specific information.	

3.4.1 20-Pin SOIC

General

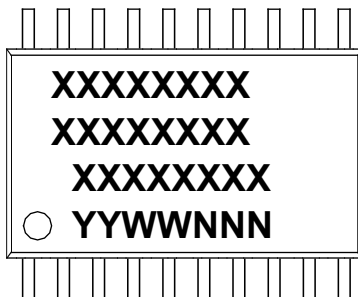


Example

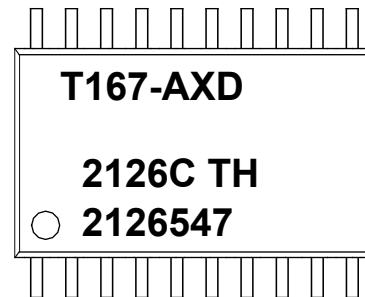


3.4.2 20-Pin TSSOP

General

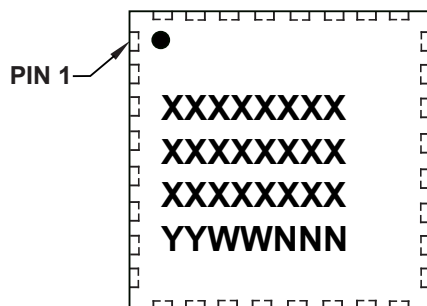


Example

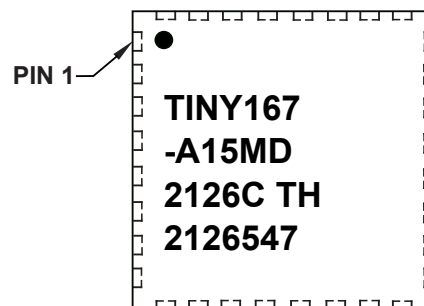


3.4.3 32-Pin VQFN

General



Example



4. Document Revision History

Note: The document revision is independent of the silicon revision.

4.1 Revision History

Doc Rev.	Date	Comments
A	09/2021	Initial release of this document • Errata content moved from the data sheet and restructured to the new document template • Data sheet clarifications added: – 3.1 Errata Section in Data Sheet is no Longer Valid – Interrupts: 3.2.1 Interrupt Vectors in ATtiny87/167 Automotive – LIN/UART: 3.3.1 Baud Rate Generator – Package Marking: 3.4 Package Marking 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 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.

THIS INFORMATION IS PROVIDED BY MICROCHIP "AS IS". MICROCHIP MAKES NO REPRESENTATIONS OR WARRANTIES OF ANY KIND WHETHER EXPRESS OR IMPLIED, WRITTEN OR ORAL, STATUTORY OR OTHERWISE, RELATED TO THE INFORMATION INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTIES OF NON-INFRINGEMENT, MERCHANTABILITY, AND FITNESS FOR A PARTICULAR PURPOSE, OR WARRANTIES RELATED TO ITS CONDITION, QUALITY, OR PERFORMANCE.

IN NO EVENT WILL MICROCHIP BE LIABLE FOR ANY INDIRECT, SPECIAL, PUNITIVE, INCIDENTAL, OR CONSEQUENTIAL LOSS, DAMAGE, COST, OR EXPENSE OF ANY KIND WHATSOEVER RELATED TO THE INFORMATION OR ITS USE, HOWEVER CAUSED, EVEN IF MICROCHIP HAS BEEN ADVISED OF THE POSSIBILITY OR THE DAMAGES ARE FORESEEABLE. TO THE FULLEST EXTENT ALLOWED BY LAW, MICROCHIP'S TOTAL LIABILITY ON ALL CLAIMS IN ANY WAY RELATED TO THE INFORMATION OR ITS USE WILL NOT EXCEED THE AMOUNT OF FEES, IF ANY, THAT YOU HAVE PAID DIRECTLY TO MICROCHIP FOR THE INFORMATION.

Use of Microchip devices in life support and/or safety applications is entirely at the buyer's risk, and the buyer agrees to defend, indemnify and hold harmless Microchip from any and all damages, claims, suits, or expenses resulting from such use. No licenses are conveyed, implicitly or otherwise, under any Microchip intellectual property rights unless otherwise stated.

Trademarks

The Microchip name and logo, the Microchip logo, Adaptec, AnyRate, AVR, AVR logo, AVR Freaks, BesTime, BitCloud, CryptoMemory, CryptoRF, dsPIC, flexPWR, HELDO, IGLOO, JukeBlox, KeeLoq, Klear, LANCheck, LinkMD, maXStylus, maXTouch, MediaLB, megaAVR, Microsemi, Microsemi logo, MOST, MOST logo, MPLAB, OptoLyzer, PIC, picoPower, PICSTART, PIC32 logo, PolarFire, Prochip Designer, QTouch, SAM-BA, SenGenuity, SpyNIC, SST, SST Logo, SuperFlash, Symmetricom, SyncServer, Tachyon, TimeSource, tinyAVR, UNI/O, Vectron, and XMEGA are registered trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

AgileSwitch, APT, ClockWorks, The Embedded Control Solutions Company, EtherSynch, Flashtec, Hyper Speed Control, HyperLight Load, IntelliMOS, Libero, motorBench, mTouch, Powermite 3, Precision Edge, ProASIC, ProASIC Plus, ProASIC Plus logo, Quiet- Wire, SmartFusion, SyncWorld, Temux, TimeCesium, TimeHub, TimePictra, TimeProvider, TrueTime, WinPath, and ZL are registered trademarks of Microchip Technology Incorporated in the U.S.A.

Adjacent Key Suppression, AKS, Analog-for-the-Digital Age, Any Capacitor, AnyIn, AnyOut, Augmented Switching, BlueSky, BodyCom, CodeGuard, CryptoAuthentication, CryptoAutomotive, CryptoCompanion, CryptoController, dsPICDEM, dsPICDEM.net, Dynamic Average Matching, DAM, ECAN, Espresso T1S, EtherGREEN, GridTime, IdealBridge, In-Circuit Serial Programming, ICSP, INICnet, Intelligent Paralleling, Inter-Chip Connectivity, JitterBlocker, Knob-on-Display, maxCrypto, maxView, memBrain, Mindi, MiWi, MPASM, MPF, MPLAB Certified logo, MPLIB, MPLINK, MultiTRAK, NetDetach, NVM Express, NVMe, Omniscient Code Generation, PICDEM, PICDEM.net, PICkit, PICtail, PowerSmart, PureSilicon, QMatrix, REAL ICE, Ripple Blocker, RTAX, RTG4, SAM-ICE, Serial Quad I/O, simpleMAP, SimpliPHY, SmartBuffer, SmartHLS, SMART-I.S., storClad, SQL, SuperSwitcher, SuperSwitcher II, Switchtec, SynchroPHY, Total Endurance, TSHARC, USBCheck, VariSense, VectorBlox, VeriPHY, ViewSpan, WiperLock, XpressConnect, and ZENA are trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

SQTP is a service mark of Microchip Technology Incorporated in the U.S.A.

The Adaptec logo, Frequency on Demand, Silicon Storage Technology, Symmcom, and Trusted Time are registered trademarks of Microchip Technology Inc. in other countries.

GestIC is a registered trademark of Microchip Technology Germany II GmbH & Co. KG, a subsidiary of Microchip Technology Inc., in other countries.

All other trademarks mentioned herein are property of their respective companies.

© 2021, Microchip Technology Incorporated and its subsidiaries. All Rights Reserved.

ISBN: 978-1-5224-8769-2

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 China - Guangzhou Tel: 86-20-8755-8029 China - Hangzhou Tel: 86-571-8792-8115 China - Hong Kong SAR Tel: 852-2943-5100 China - Nanjing Tel: 86-25-8473-2460 China - Qingdao Tel: 86-532-8502-7355 China - Shanghai Tel: 86-21-3326-8000 China - Shenyang Tel: 86-24-2334-2829 China - Shenzhen Tel: 86-755-8864-2200 China - Suzhou Tel: 86-186-6233-1526 China - Wuhan Tel: 86-27-5980-5300 China - Xian Tel: 86-29-8833-7252 China - Xiamen Tel: 86-592-2388138 China - Zhuhai Tel: 86-756-3210040	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 Korea - Daegu Tel: 82-53-744-4301 Korea - Seoul Tel: 82-2-554-7200 Malaysia - Kuala Lumpur Tel: 60-3-7651-7906 Malaysia - Penang Tel: 60-4-227-8870 Philippines - Manila Tel: 63-2-634-9065 Singapore Tel: 65-6334-8870 Taiwan - Hsin Chu Tel: 886-3-577-8366 Taiwan - Kaohsiung Tel: 886-7-213-7830 Taiwan - Taipei Tel: 886-2-2508-8600 Thailand - Bangkok Tel: 66-2-694-1351 Vietnam - Ho Chi Minh Tel: 84-28-5448-2100	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 Fax: 33-1-69-30-90-79 Germany - Garching Tel: 49-8931-9700 Germany - Haan Tel: 49-2129-3766400 Germany - Heilbronn Tel: 49-7131-72400 Germany - Karlsruhe Tel: 49-721-625370 Germany - Munich Tel: 49-89-627-144-0 Fax: 49-89-627-144-44 Germany - Rosenheim Tel: 49-8031-354-560 Israel - Ra'anana Tel: 972-9-744-7705 Italy - Milan Tel: 39-0331-742611 Fax: 39-0331-466781 Italy - Padova Tel: 39-049-7625286 Netherlands - Drunen Tel: 31-416-690399 Fax: 31-416-690340 Norway - Trondheim Tel: 47-72884388 Poland - Warsaw Tel: 48-22-3325737 Romania - Bucharest Tel: 40-21-407-87-50 Spain - Madrid Tel: 34-91-708-08-90 Fax: 34-91-708-08-91 Sweden - Gothenberg Tel: 46-31-704-60-40 Sweden - Stockholm Tel: 46-8-5090-4654 UK - Wokingham Tel: 44-118-921-5800 Fax: 44-118-921-5820