# MX852BB0030

## Ultra-Low Jitter XTAL Oscillator with Fanout

### Features

- Generates Five Output Clocks
- Frequency and Output Logic:
  - 156.25 MHz HCSL x 5
- Integrated Quartz Crystal for Frequency Reference
- Typical Phase Noise:
  - 73 fs (Integration Range: 1.875 MHz to 20 MHz)
  - 162 fs (Integration Range: 12 kHz to 20 MHz)
- Complete Ultra-Low Jitter Clocking Solution
- OE on Bank 1 and Bank 2
- 2.5V or 3.3V Operating Voltage Range
- ±50 ppm Total Stability
- –40°C to +85°C Temperature Range
- 38-Pin 5 mm x 7 mm LGA Package

### Applications

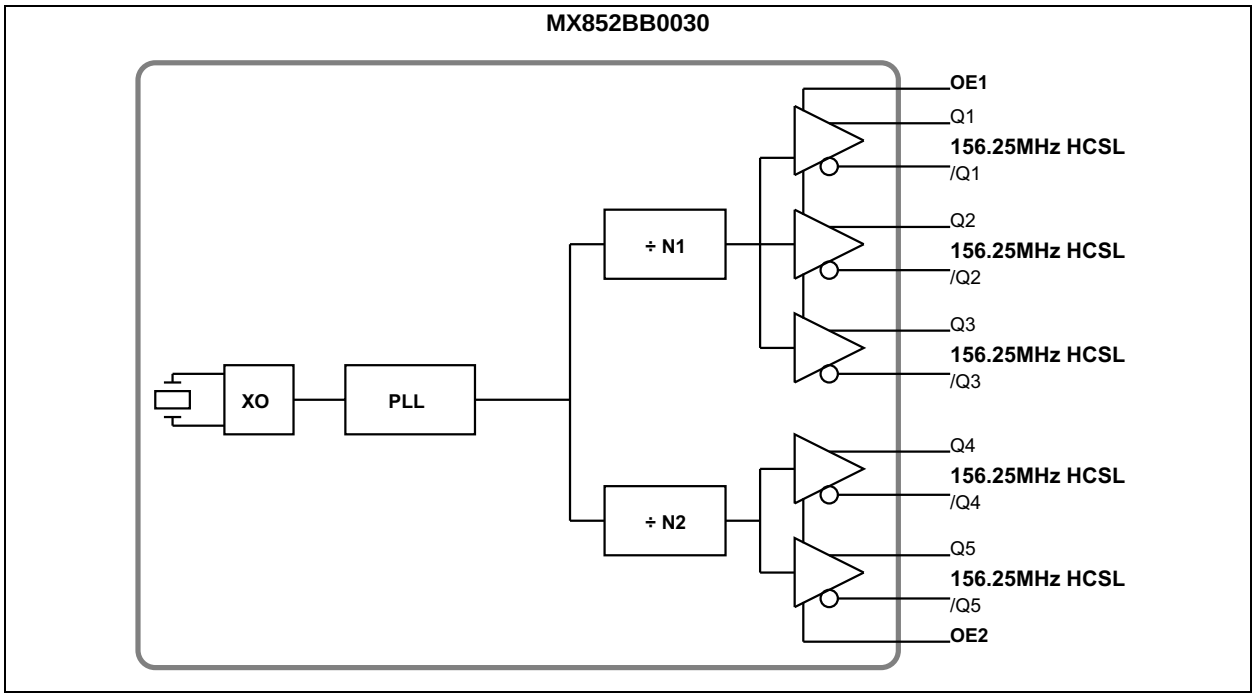
- 10/40/100 Gigabit Ethernet
- Fibre Channel 10G/12G SERDES

### General Description

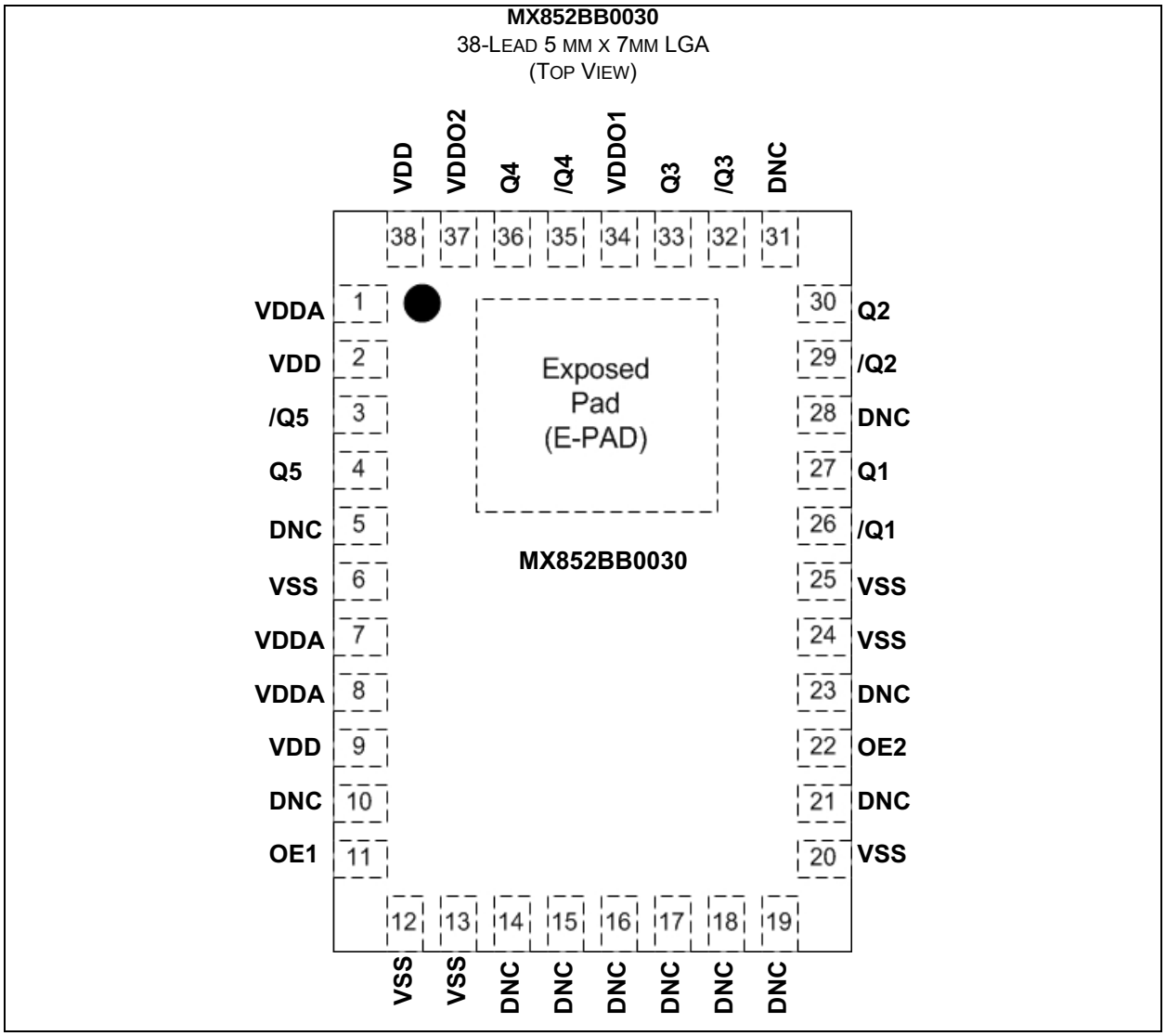
The MX852BB0030 clock management IC (CMIC) is a member of the ClockWorks® FUSION family of devices that integrates the crystal, synthesizer, and fanout buffers in a single 5 mm x 7 mm LGA package.

Integrating the entire clock chain delivers 162 fs typical phase noise performance, including fanout and crosstalk. The device operates from a 2.5V or 3.3V power supply.

### Block Diagram



## Package Type



# 1.0 ELECTRICAL CHARACTERISTICS

## Absolute Maximum Ratings †

Supply Voltage ($V_{DDA}$, $V_{DD}$, $V_{DDOx}$) ..... +4.6V
Input Voltage ($V_{IN}$) ..... –0.5V to $V_{DD}$+0.5V
ESD Human Body Model Rating ..... 2 kV
ESD Machine Model Rating ..... 200V

## Operating Ratings ‡

Supply Voltage ($V_{DDOx}$, $V_{DD}$, $V_{DDA}$) ..... +2.375V to +3.465V

† **Notice:** Stresses above those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at those or any other conditions above those indicated in the operational sections of this specification is not intended. Exposure to maximum rating conditions for extended periods may affect device reliability.

‡ **Notice:** The device is not guaranteed to function outside its operating ratings.

### TABLE 1-1: ELECTRICAL CHARACTERISTICS (Note 1)

**Electrical Characteristics:** $V_{DD} = V_{DDA} = V_{DDO1} = V_{DDO2}$ = 3.3V ±5% or 2.5V ±5%;
$V_{DD} = V_{DDA}$ = 3.3V ±5%, $V_{DDO1} = V_{DDO2}$ = 3.3V ±5% or 2.5V ±5%; $T_A$ = –40°C to +85°C, unless otherwise noted.

| Parameter | Symbol | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| 2.5V Operating Voltage | $V_{DDx}$ | 2.375 | 2.5 | 2.625 | V | — |
| 3.3V Operating Voltage | | 3.135 | 3.3 | 3.465 | | — |
| Core Supply Current | $I_{DD}$ | — | — | 210 | mA | Outputs not loaded. |
| Output Frequency | $f_O$ | — | 156.25 | — | MHz | Bank 1 and Bank 2 |
| Frequency Stability | $f_{STABILITY}$ | — | — | ±20 | ppm | Note 2, Frequency stability over temperature |
| | | — | — | ±50 | | Total stability |
| Start-Up Time | $t_{START}$ | — | — | 20 | ms | — |
| Output-to-Output Skew | $t_{SKEW}$ | — | — | 50 | ps | Note 3 |
| Output Rise/Fall Time | $t_r/t_f$ | 150 | 300 | 450 | ps | 20% - 80%, HCSL output |
| Output Duty Cycle | ODC | 48 | 50 | 52 | % | <350 MHz output frequencies |
| RMS Phase Noise 156.25 MHz HCSL | $t_{jit(Ø)}$ | — | 73 | — | fs | Integration range (1.875 MHz to 20 MHz) |
| | | — | 162 | — | | Integration range (12 kHz to 20 MHz) |
| | | — | 260 | — | | Integration range (12 kHz to 40 MHz) |
| Period Jitter | | — | 1.6 | 5 | ps | Peak-to-peak (E5001A, 100 Hz to 40 MHz) |
| | | — | 135 | — | fs | RMS (E5001A, 100 Hz to 40 MHz) |
| | | — | 5 | 10 | ps | Peak-to-peak (10k Samples, DSA80000B) |

**Note 1:** The circuit is designed to meet the AC and DC specifications shown in the Electrical Characteristics table after thermal equilibrium has been established.

**2:** Inclusive of temperature drift, aging, initial accuracy, shock, and vibration. Operating temperature range dependent on part number configuration.

**3:** Skew between output buffers. Measured at the output differential crossing points. Applies to outputs at the same supply voltage using same output format.

### TABLE 1-2: LVCMOS INPUTS DC ELECTRICAL CHARACTERISTICS (OE1, OE2)(Note 1)

**Electrical Characteristics:** $V_{DD}$ = 3.3V ±5% or 2.5V ±5%, $T_A$ = –40°C to +85°C

| Parameter | Symbol | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| Input High Voltage | $V_{IH}$ | 2 | — | $V_{DD}$+ 0.3 | V | — |
| Input Low Voltage | $V_{IL}$ | –0.3 | — | 0.8 | V | — |
| Input High Current | $I_{IH}$ | — | — | 150 | µA | $V_{DD} = V_{IN}$ = 3.465V |
| Input Low Current | $I_{IL}$ | –150 | — | — | µA | $V_{DD}$ = 3.465V, $V_{IN}$ = 0V |

**Note 1:** The circuit is designed to meet the AC and DC specifications shown in the Electrical Characteristics table after thermal equilibrium has been established.

**TABLE 1-3: HCSL DC ELECTRICAL CHARACTERISTICS (Note 1)**

**Electrical Characteristics:** $V_{DD}$ = $V_{DDO1}$ = $V_{DDO2}$ = 3.3V ±5% or 2.5V ±5%;
$V_{DD}$ = 3.3V ±5%, $V_{DDO1}$ = $V_{DDO2}$ = 3.3V ±5% or 2.5V ±5%; $T_A$ = –40°C to +85°C, $R_L$ = 50Ω to $V_{SS}$

| Parameter | Symbol | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| Output High Voltage | $V_{OH}$ | 640 | 700 | 850 | mV | — |
| Output Low Voltage | $V_{OL}$ | –150 | 0 | 27 | mV | — |
| Crossing Point Voltage | $V_{CROSS}$ | 250 | 350 | 550 | mV | — |

**Note 1:** The circuit is designed to meet the AC and DC specifications shown in the Electrical Characteristics table after thermal equilibrium has been established.

## TEMPERATURE SPECIFICATIONS (Note 1)

| Parameters | Sym. | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| **Temperature Ranges** | | | | | | |
| Storage Temperature | $T_S$ | –65 | — | +150 | °C | — |
| Lead Temperature | — | — | — | +260 | °C | Soldering, 20 sec. |
| Ambient Temperature | $T_A$ | –40 | — | +85 | °C | — |
| **Package Thermal Resistance** | | | | | | |
| Thermal Resistance 38-Ld LGA | $\theta_{JA}$ | — | 38.5 | — | °C/W | Still Air |

**Note 1:** The maximum allowable power dissipation is a function of ambient temperature, the maximum allowable junction temperature and the thermal resistance from junction to air (i.e., $T_A$, $T_J$, $\theta_{JA}$). Exceeding the maximum allowable power dissipation will cause the device operating junction temperature to exceed the maximum +125°C rating. Sustained junction temperatures above +125°C can impact the device reliability.

## 2.0 PIN DESCRIPTIONS

The descriptions of the pins are listed in Table 2-1.

**TABLE 2-1: PIN FUNCTION TABLE**

| Pin Number | Pin Name | Pin Type | Pin Level | Description |
|---|---|---|---|---|
| 1, 7, 8 | VDDA | PWR | — | Analog Power Supply |
| 2, 9, 38 | VDD | PWR | — | Power Supply |
| 3, 4 | /Q5, Q5 | O, Diff | HCSL | Bank 2 Clock Output Frequency = 156.25 MHz |
| 5, 14, 15, 16, 17, 18, 19, 21, 23, 28, 31 | DNC | — | — | Do not connect anything to these pins. |
| 6, 24, 25, ePAD | VSS (Exposed Pad) | PWR | — | Power Supply Ground. The exposed pad must be connected to the VSS ground plane. |
| 10 | DNC | — | — | Do not connect. |
| 11 | OE1 | I, SE | LVCMOS | Output Enable, Bank 1 outputs disable to tri-state, 0 = Disabled, 1 = Enabled, 45 kΩ pull-up. |
| 12, 13, 20 | VSS | PWR | — | Crystal Ground |
| 22 | OE2 | I, SE | LVCMOS | Output Enable, Bank 2 outputs disable to tri-state, 0 = Disabled, 1 = Enabled, 45 kΩ pull-up. |
| 26, 27 | /Q1, Q1 | O, Diff | HCSL | Bank 1 Clock Output Frequency = 156.25 MHz |
| 29, 30 | /Q2, Q2 | O, Diff | HCSL | Bank 1 Clock Output Frequency = 156.25 MHz |
| 32, 33 | /Q3, Q3 | O, Diff | HCSL | Bank 1 Clock Output Frequency = 156.25 MHz |
| 34 | VDDO1 | PWR | — | Power Supply for the outputs on Bank 1 |
| 35, 36 | /Q4, Q4 | O, Diff | HCSL | Bank 2 Clock Output Frequency = 156.25 MHz |
| 37 | VDDO2 | PWR | — | Power Supply for the outputs on Bank 2 |

# 3.0 APPLICATION INFORMATION

## 3.1 Output Traces

Design the traces for the output signals according to the output logic requirements. If LVCMOS is unterminated, add a 30Ω resistor in series with the output, as close as possible to the output pin and start a 50Ω trace on the other side of the resistor.

For differential traces you can either use a differential design or two separate 50Ω traces.

For EMI reasons, it is better to use a balanced differential design. LVDS can be AC-coupled or DC-coupled to its termination.

## 3.2 Power Supply Decoupling

Place the smallest value decoupling capacitor (4.7 nF below) between the $V_{DD}$ and $V_{SS}$ pins, as close as possible to those pins and on the same side of the PCB as the IC. The shorter the physical path from $V_{DD}$ to the capacitor and back from the capacitor to $V_{SS}$, the more effective the decoupling. Use one 4.7 nF capacitor for each $V_{DD}$ pin.

The impedance value of the Ferrite Bead (FB) needs to be between 80Ω and 240Ω with a saturation current ≥250 mA.

The $V_{DDO1}$ and $V_{DDO2}$ pins connect directly to the $V_{DD}$ plane. All $V_{DD}$ pins connect to $V_{DD}$ after the power supply filter.

## 4.0 POWER SUPPLY FILTERING RECOMMENDATIONS

Preferred filtering, using a Microchip MIC94325 Ripple Block, is shown in Figure 4-1.

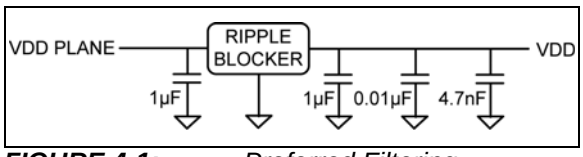



***FIGURE 4-1:*** *Preferred Filtering.*

Figure 4-2 shows an alternative, traditional filter, using a ferrite bead.

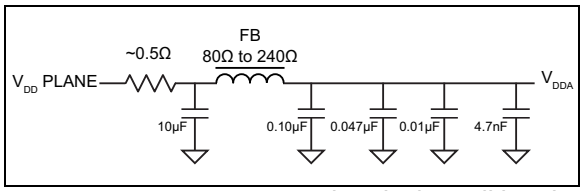



***FIGURE 4-2:*** *VDDA (Analog) Traditional Pi Filter.*

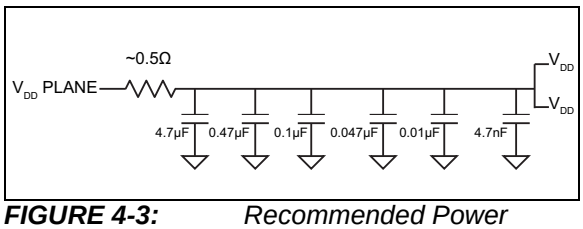



***FIGURE 4-3:*** *Recommended Power Supply Filtering.*

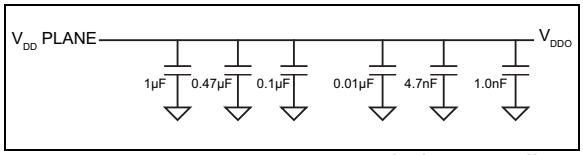



***FIGURE 4-4:*** *Recommended Decoupling for Each VDDO.*

## 5.0 TIMING DIAGRAMS

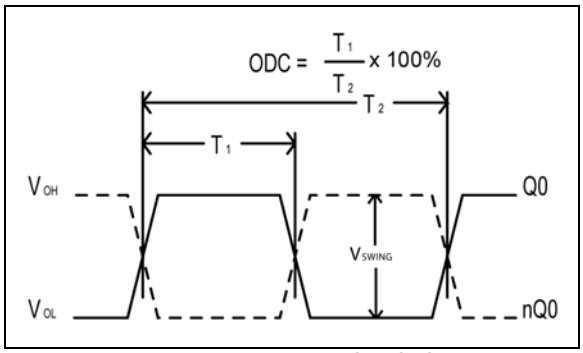



***FIGURE 5-1:*** *Duty Cycle Timing.*

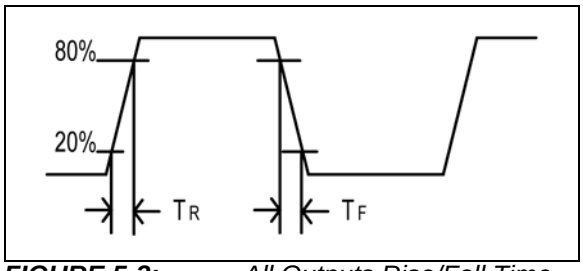



***FIGURE 5-2:*** *All Outputs Rise/Fall Time.*

## 6.0 RMS PHASE/NOISE/JITTER

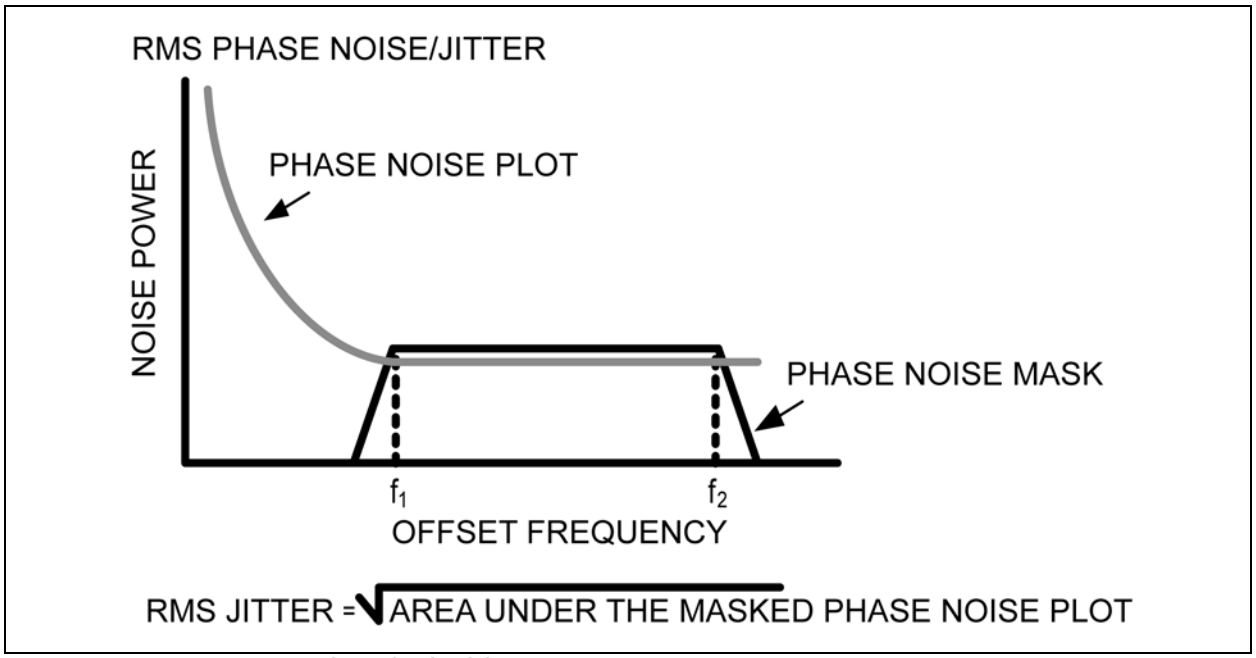



***FIGURE 6-1:*** *RMS Phase/Noise/Jitter.*

## 7.0 OUTPUT TERMINATION

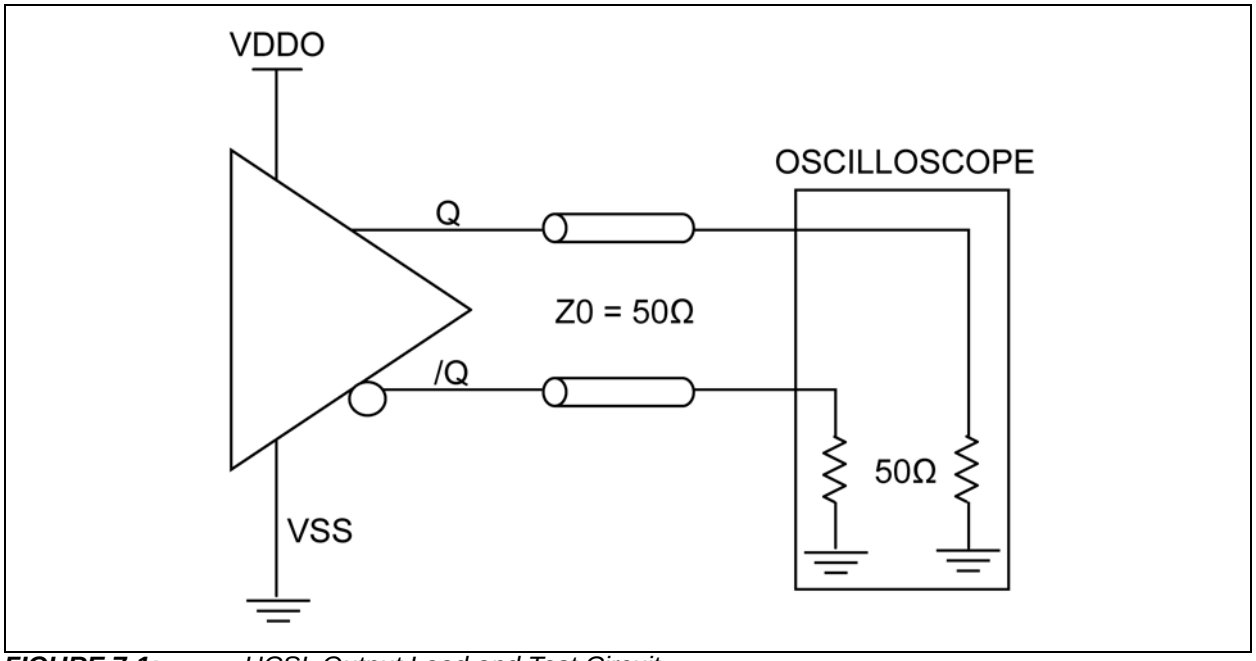



***FIGURE 7-1:*** *HCSL Output Load and Test Circuit.*

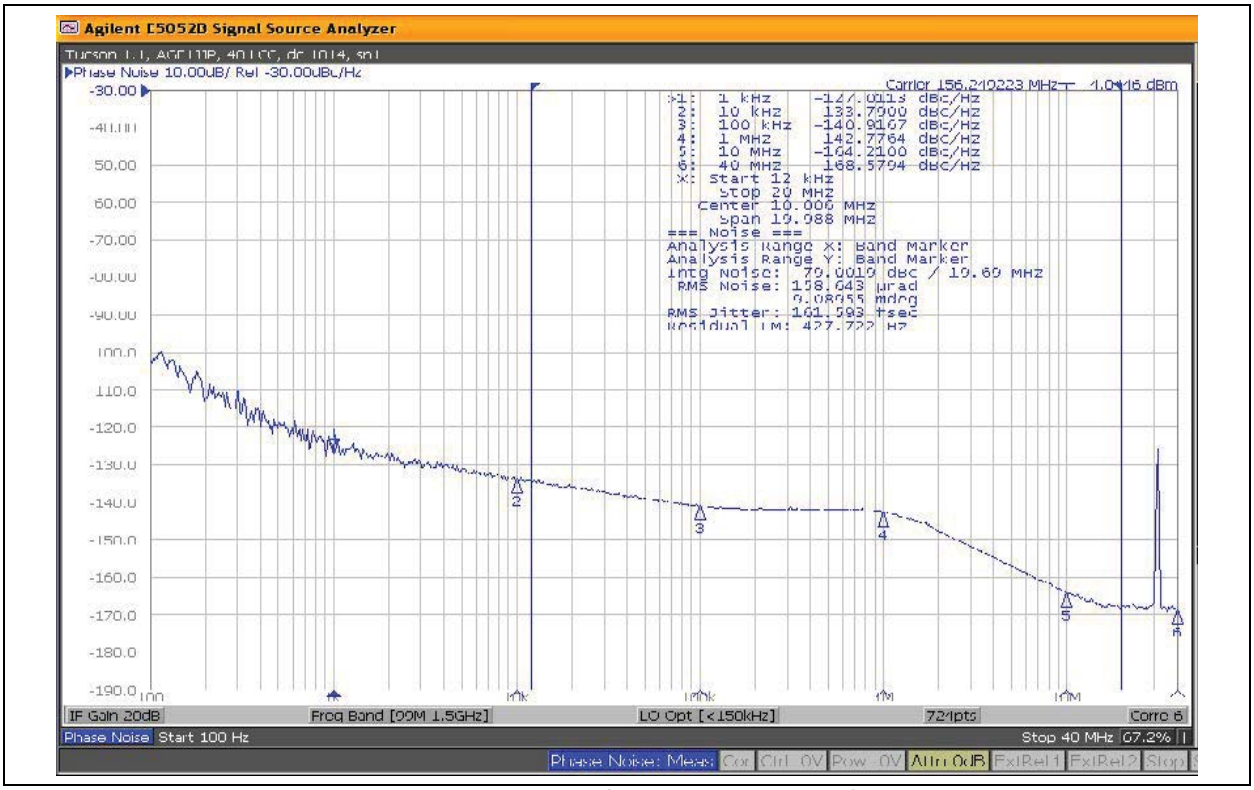



***FIGURE 7-2:*** *156.25 MHz HCSL Output, 12 kHz to 20 MHz, 162 fs*

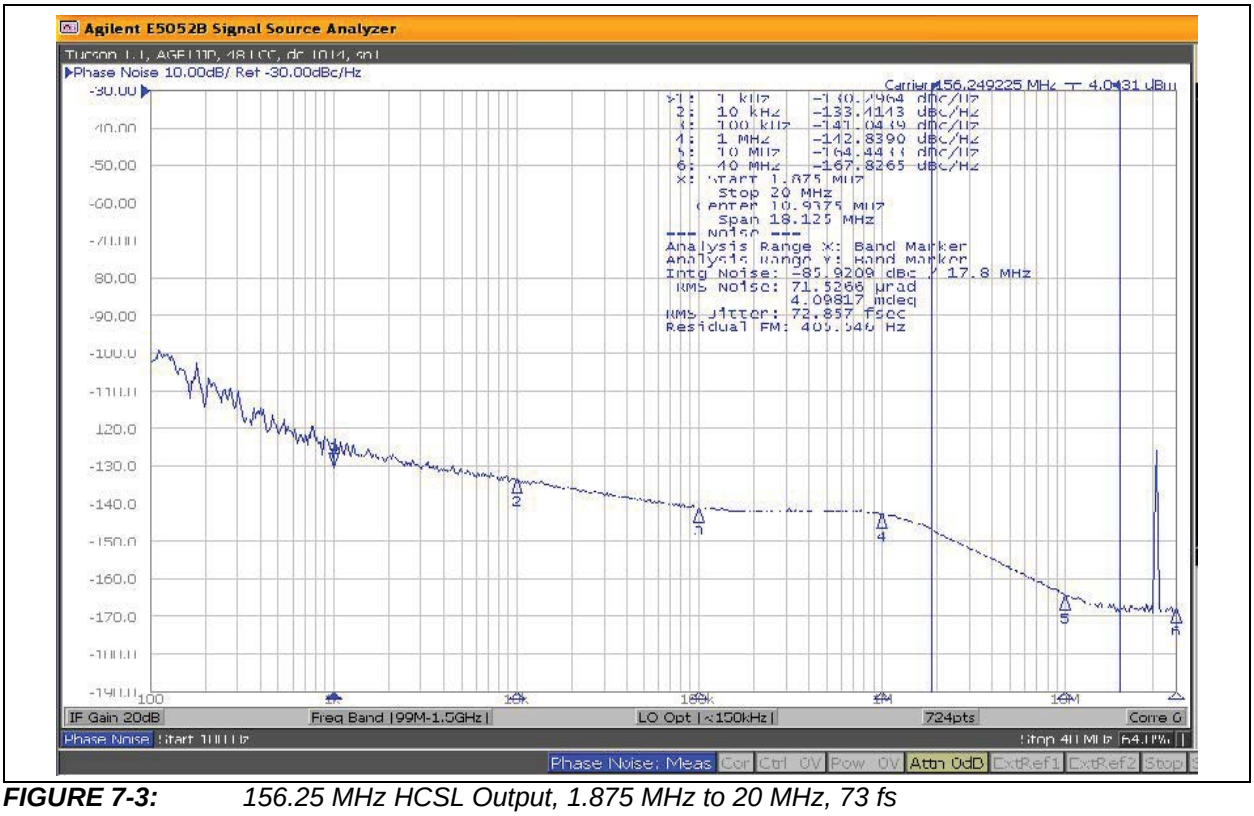



***FIGURE 7-3:*** *156.25 MHz HCSL Output, 1.875 MHz to 20 MHz, 73 fs*

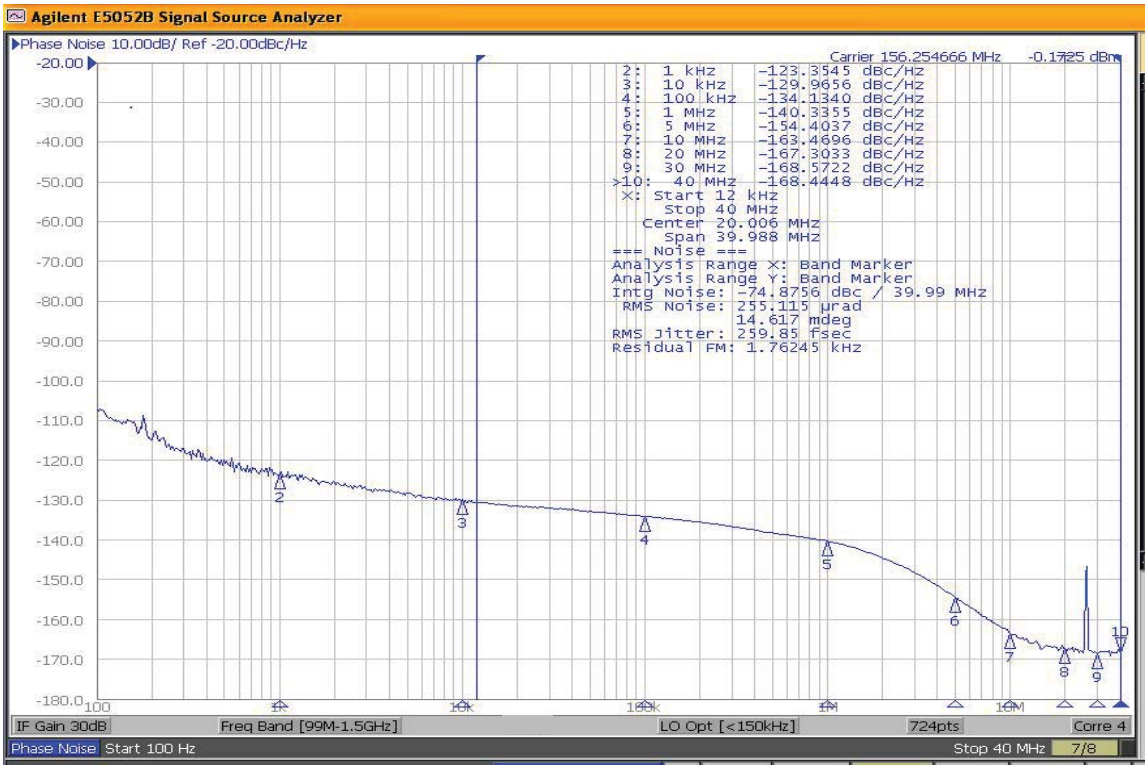



***FIGURE 7-4:*** *156.25 MHz HCSL Output, 12 kHz to 40 MHz, 260 fs*

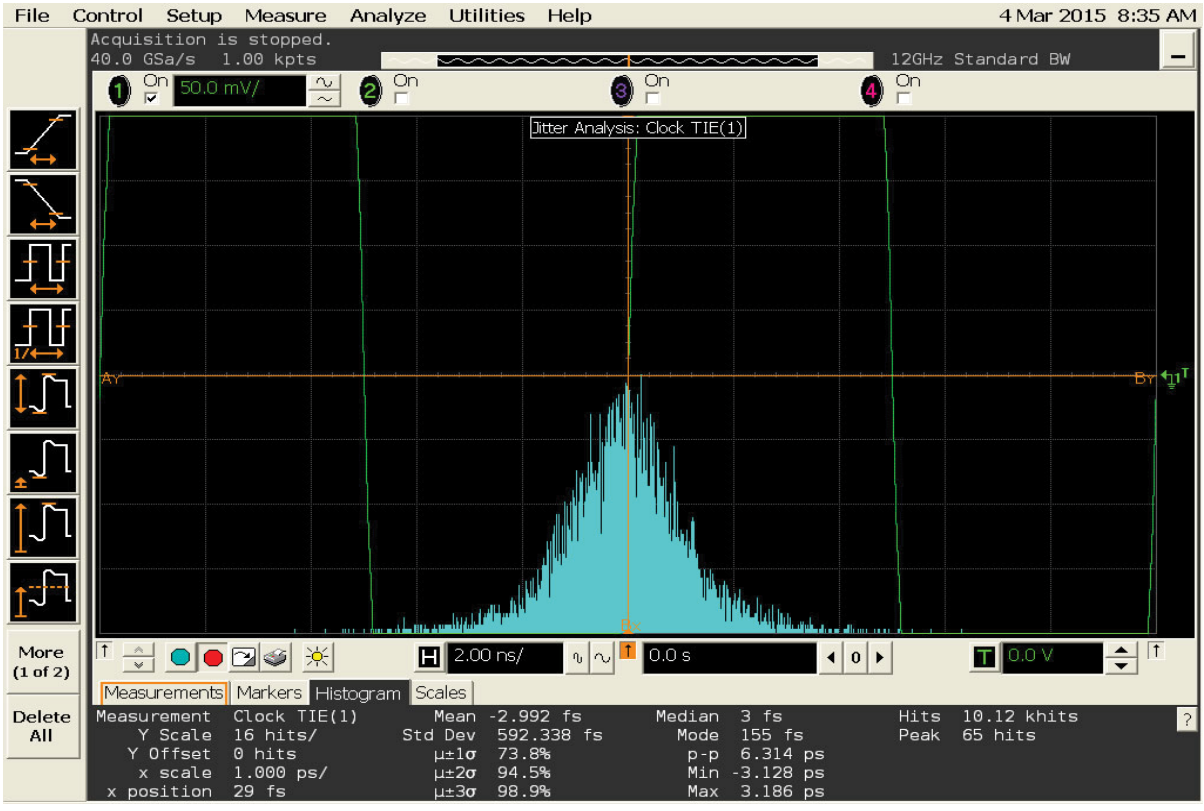


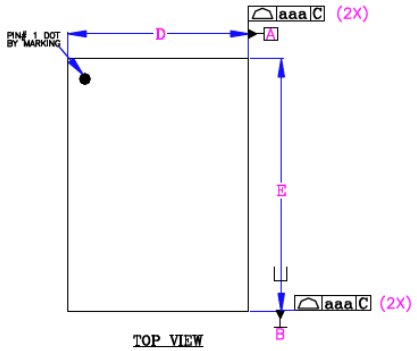

***FIGURE 7-5:*** *TIE Jitter (10k Samples).*

## 8.0 PACKAGING INFORMATION

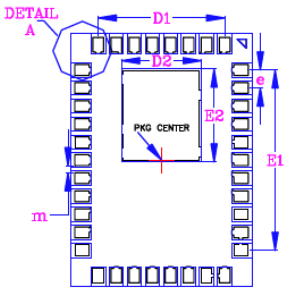
### 38-Lead LGA Package Outline and Recommended Land Pattern

**TITLE**
38 LEAD LGA 7x5 mm PACKAGE OUTLINE & RECOMMENDED LAND PATTERN

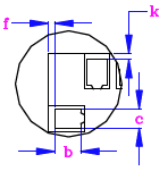
| DRAWING # | LGA75-38LD-PL-1 | UNIT | MM |
|---|---|---|---|



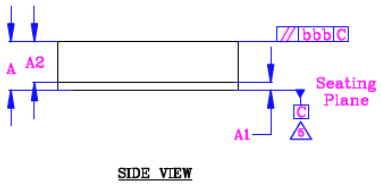

TOP VIEW



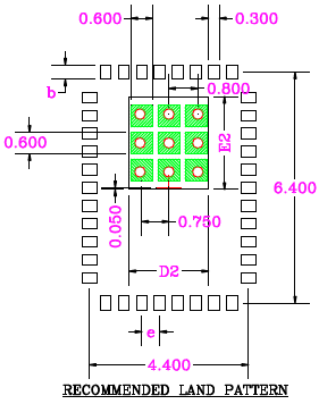

BOTTOM VIEW




DETAIL A
SCALE 5:1




SIDE VIEW




RECOMMENDED LAND PATTERN

| Dimensional Tol. | |
|---|---|
| aaa | 0.100 |
| bbb | 0.070 |

| Dimensional Ref. | | | |
|---|---|---|---|
| REF. | Min. | Nom | Max. |
| A | 1.310 | 1.380 | 1.450 |
| A1 | 0.240 | 0.280 | 0.320 |
| A2 | 1.070 | 1.100 | 1.130 |
| D | 4.900 | 5.000 | 5.100 |
| D1 | | 3.500 BSC | |
| D2 | 2.100 | 2.200 | 2.300 |
| E | 6.900 | 7.000 | 7.100 |
| E1 | | 5.000 BSC | |
| E2 | 2.475 | 2.575 | 2.675 |
| b | 0.350 | 0.400 | 0.450 |
| c | 0.250 | 0.300 | 0.350 |
| e | | 0.5000 BSC | |
| f | 0.050 | 0.100 | 0.150 |
| k | 0.050 | 0.100 | 0.150 |
| m | 0.150 | 0.200 | 0.250 |
| n | | 38 | |

Notes:
1. Dimensioning and Tolerancing per ASME Y14.5M-1994.
2. Dimensions are in millimeters.
3. 'e' represents the basic LGA pitch
4. 'n' is the maximum no. of Land for a specified Package.
5. Package warp shall be 0.050 max.
6. Substrate base is BT Resin
7. The Pin#1 corner must be identified on top side only.
8. Reference JEDEC Spec M0-220.
9. Red circles in land pattern indicate thermal via. Size should be 0.30mm in diameter. Pitch is 0.80mm and connected to GND for maximum thermal performance.
10. Green rectangles (SHADED AREA) indicate solder stencil opening on exposed pad area. Size is 0.60x0.60mm. Pitch is 0.75mm
11. Land Pattern Tolerance is ±0.02mm.

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging.

**NOTES:**

# APPENDIX A: REVISION HISTORY

## Revision A (October 2018)

- Converted Micrel document MX852BB0030 to Microchip data sheet DS20005737A.
- Minor text changes throughout.

**NOTES:**

## PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, contact your local Microchip representative or sales office.

| PART NO. | – | XX |
|---|---|---|
| Device | | Media Type |

| | | |
|---|---|---|
| **Device:** | MX852BB0030: | Ultra-Low Jitter 5 HCSL Output Oscillator at 156.25 MHz |
| **Media Type:** | (blank)= | 43/Tube |
| | TR = | 1,000/Reel |

**Examples:**

a) MX852BB0030: Ultra-Low Jitter 5 HCSL Output Oscillator at 156.25 MHz, 43/Tube

b) MX852BB0030-TR: Ultra-Low Jitter 5 HCSL Output Oscillator at 156.25 MHz, 1,000/Reel

**Note 1:** Tape and Reel identifier only appears in the catalog part number description. This identifier is used for ordering purposes and is not printed on the device package. Check with your Microchip Sales Office for package availability with the Tape and Reel option.

**NOTES:**

**Note the following details of the code protection feature on Microchip devices:**

- Microchip products meet the specification contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is one of the most secure families of its kind on the market today, when used in the intended manner and under normal conditions.
- There are dishonest and possibly illegal methods used to breach the code protection feature. All of these methods, to our knowledge, require using the Microchip products in a manner outside the operating specifications contained in Microchip's Data Sheets. Most likely, the person doing so is engaged in theft of intellectual property.
- Microchip is willing to work with the customer who is concerned about the integrity of their code.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of their code. Code protection does not mean that we are guaranteeing the product as "unbreakable."

Code protection is constantly evolving. We at Microchip are committed to continuously improving the code protection features of our products. Attempts to break Microchip's code protection feature may be a violation of the Digital Millennium Copyright Act. If such acts allow unauthorized access to your software or other copyrighted work, you may have a right to sue for relief under that Act.



*Microchip received ISO/TS-16949:2009 certification for its worldwide headquarters, design and wafer fabrication facilities in Chandler and Tempe, Arizona; Gresham, Oregon and design centers in California and India. The Company's quality system processes and procedures are for its PIC® MCUs and dsPIC® DSCs, KEELOQ® code hopping devices, Serial EEPROMs, microperipherals, nonvolatile memory and analog products. In addition, Microchip's quality system for the design and manufacture of development systems is ISO 9001:2000 certified.*

**QUALITY MANAGEMENT SYSTEM**
**CERTIFIED BY DNV**
**═ ISO/TS 16949 ═**

**Trademarks**



ISBN: 978-1-5224-3612-6

# Worldwide Sales and Service

## AMERICAS

**Corporate Office**
2355 West Chandler Blvd.
Chandler, AZ 85224-6199
Tel: 480-792-7200
Fax: 480-792-7277
Technical Support:
http://www.microchip.com/support
Web Address:
www.microchip.com

**Atlanta**
Duluth, GA
Tel: 678-957-9614
Fax: 678-957-1455

**Austin, TX**
Tel: 512-257-3370

**Boston**
Westborough, MA
Tel: 774-760-0087
Fax: 774-760-0088

**Chicago**
Itasca, IL
Tel: 630-285-0071
Fax: 630-285-0075

**Dallas**
Addison, TX
Tel: 972-818-7423
Fax: 972-818-2924

**Detroit**
Novi, MI
Tel: 248-848-4000

**Houston, TX**
Tel: 281-894-5983

**Indianapolis**
Noblesville, IN
Tel: 317-773-8323
Fax: 317-773-5453
Tel: 317-536-2380

**Los Angeles**
Mission Viejo, CA
Tel: 949-462-9523
Fax: 949-462-9608
Tel: 951-273-7800

**Raleigh, NC**
Tel: 919-844-7510

**New York, NY**
Tel: 631-435-6000

**San Jose, CA**
Tel: 408-735-9110
Tel: 408-436-4270

**Canada - Toronto**
Tel: 905-695-1980
Fax: 905-695-2078

## ASIA/PACIFIC

**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

## ASIA/PACIFIC

**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

## EUROPE

**Austria - Wels**
Tel: 43-7242-2244-39
Fax: 43-7242-2244-393

**Denmark - Copenhagen**
Tel: 45-4450-2828
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: 49-7131-67-3636

**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: 47-7288-4388

**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