

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 $+85^{\circ}\text{C}$ Temperature Range
- 38-Pin 5 mm x 7 mm LGA Package

Applications

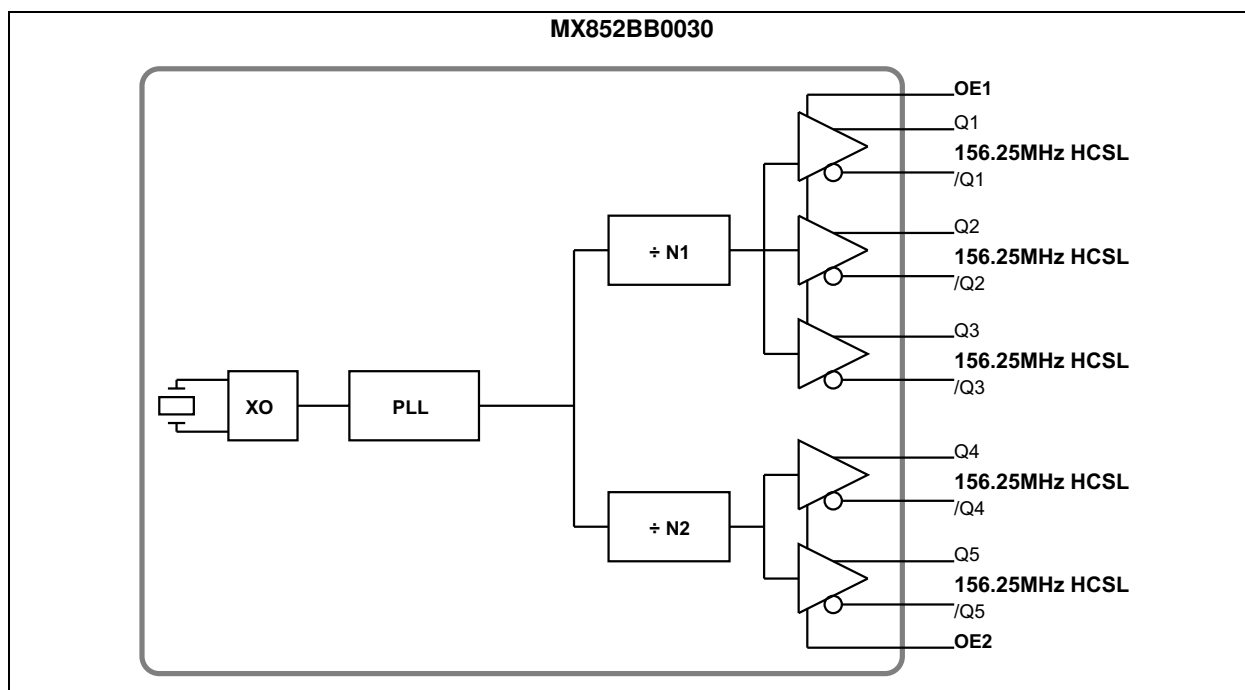
- 10/40/100 Gigabit Ethernet
- Fibre Channel 10G/12G SERDES

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.

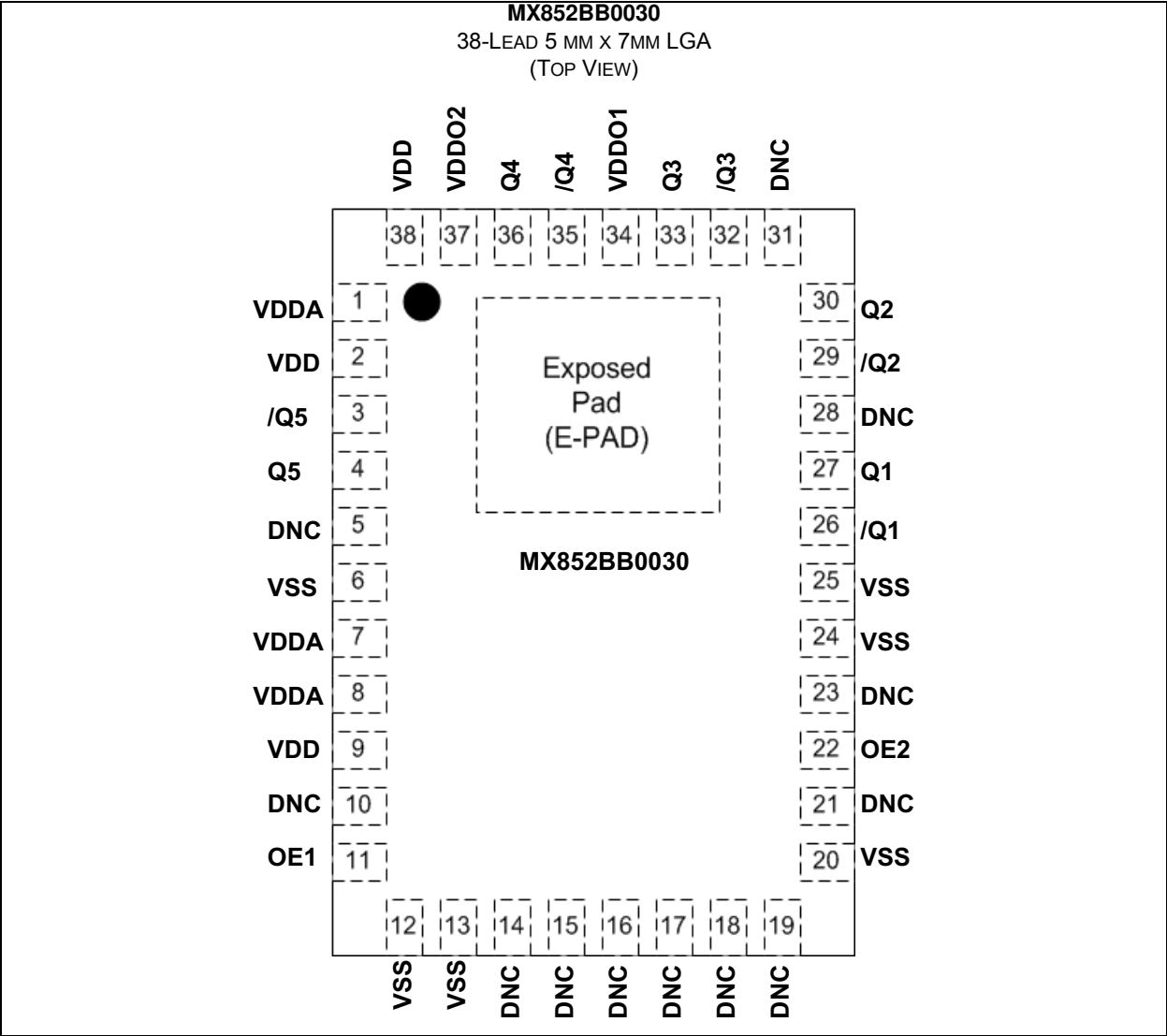
Integrating the entire clock chain delivers 162 fs typical phase noise performance, including fanout and crosstalk. The device operates from a 2.5V or 3.3V power supply.

Block Diagram



MX852BB0030

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.

MX852BB0030

TABLE 1-1: ELECTRICAL CHARACTERISTICS (Note 1)

Electrical Characteristics: $V_{DD} = V_{DDA} = V_{DDO1} = V_{DDO2} = 3.3V \pm 5\%$ or $2.5V \pm 5\%$;
 $V_{DD} = V_{DDA} = 3.3V \pm 5\%$, $V_{DDO1} = V_{DDO2} = 3.3V \pm 5\%$ or $2.5V \pm 5\%$; $T_A = -40^\circ C$ to $+85^\circ C$, 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	$t_{jit}(\emptyset)$	—	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	$t_{jit}(\emptyset)$	—	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: $V_{DD} = 3.3V \pm 5\%$ or $2.5V \pm 5\%$, $T_A = -40^\circ C$ to $+85^\circ C$

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: $V_{DD} = V_{DDO1} = V_{DDO2} = 3.3V \pm 5\%$ or $2.5V \pm 5\%$;

$V_{DD} = 3.3V \pm 5\%$, $V_{DDO1} = V_{DDO2} = 3.3V \pm 5\%$ or $2.5V \pm 5\%$; $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$, $R_L = 50\Omega$ 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.

MX852BB0030

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	θ_{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 , θ_{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	LVC MOS	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	LVC MOS	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

MX852BB0030

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](#).

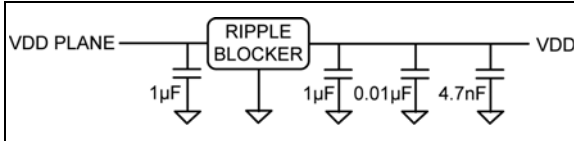


FIGURE 4-1: Preferred Filtering.

[Figure 4-2](#) shows an alternative, traditional filter, using a ferrite bead.

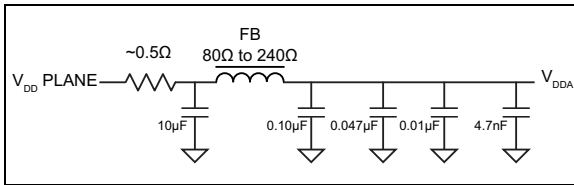


FIGURE 4-2: VDDA (Analog) Traditional Pi Filter.

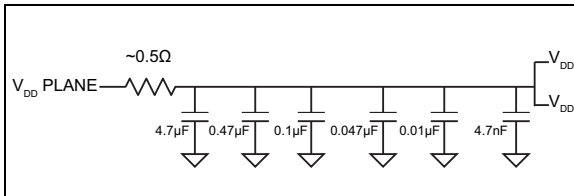


FIGURE 4-3: Recommended Power Supply Filtering.

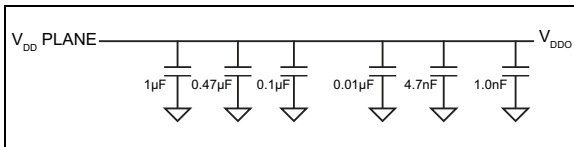


FIGURE 4-4: Recommended Decoupling for Each VDDO.

5.0 TIMING DIAGRAMS

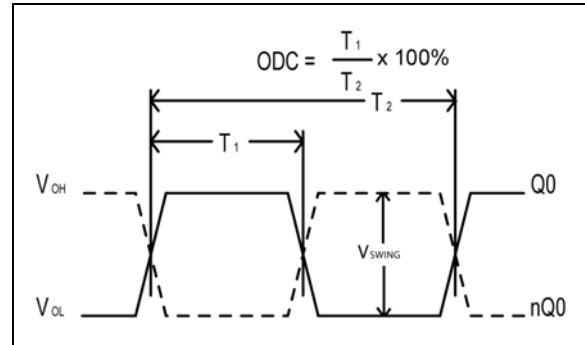


FIGURE 5-1: Duty Cycle Timing.

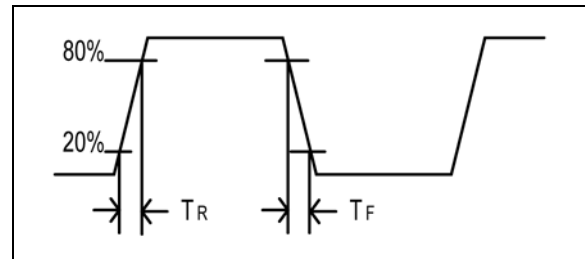


FIGURE 5-2: All Outputs Rise/Fall Time.

MX852BB0030

6.0 RMS PHASE/NOISE/JITTER

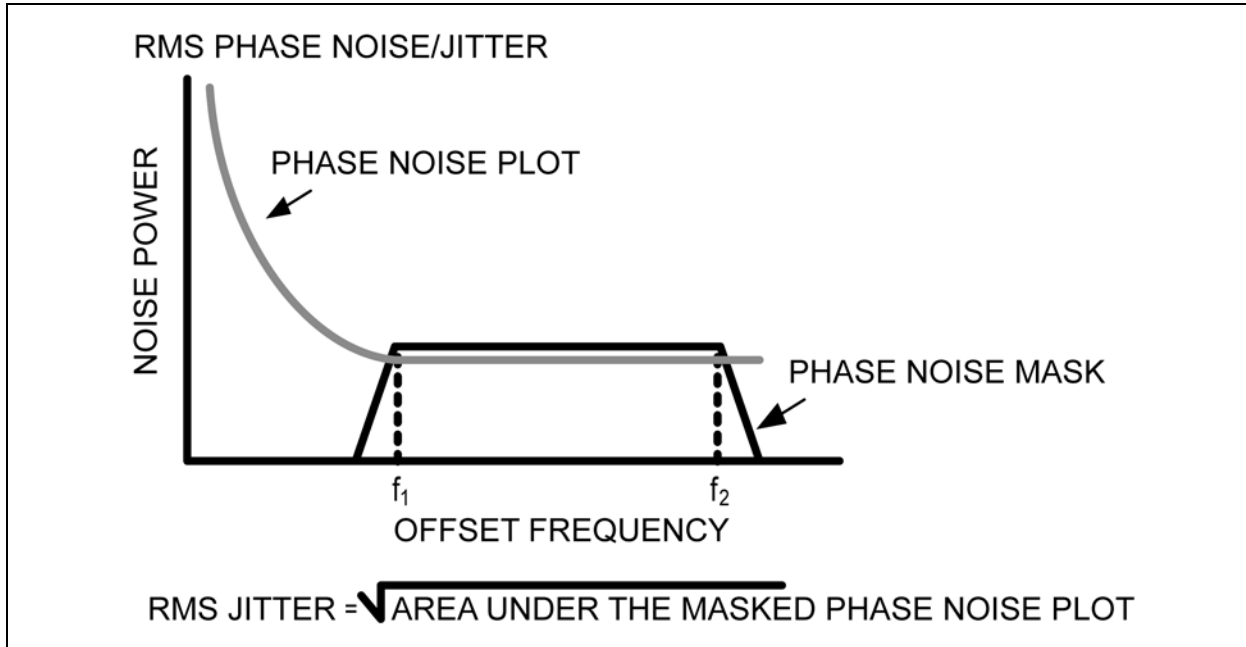


FIGURE 6-1: RMS Phase/Noise/Jitter.

7.0 OUTPUT TERMINATION

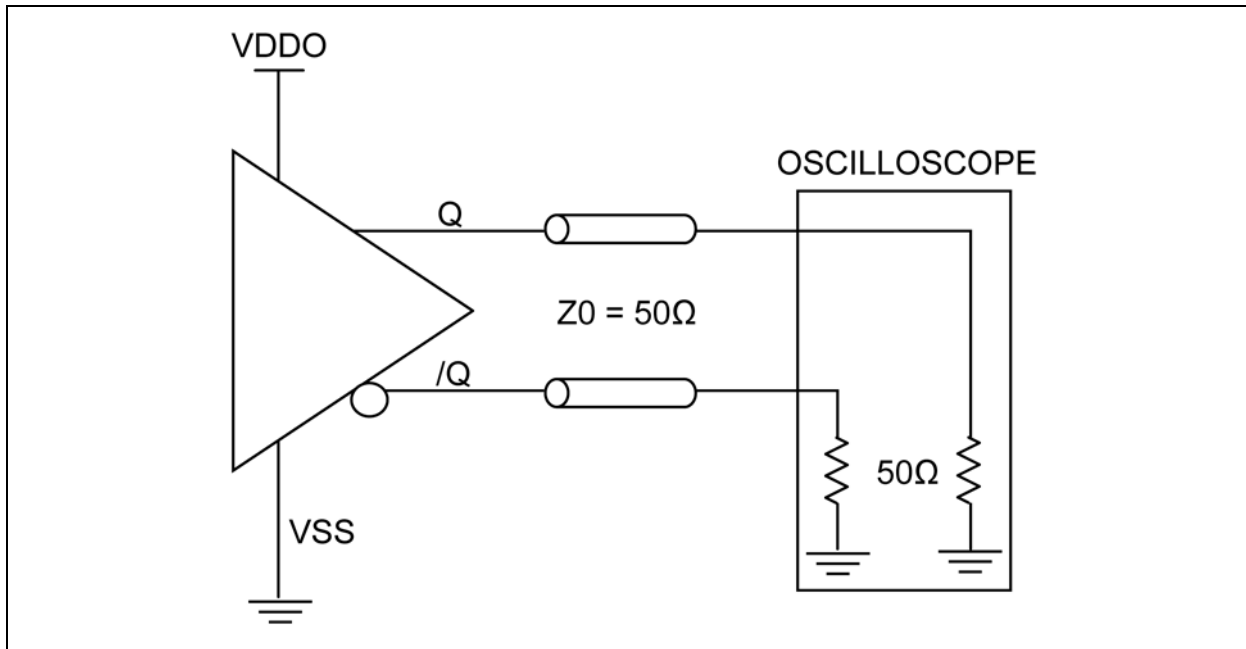


FIGURE 7-1: HCSL Output Load and Test Circuit.

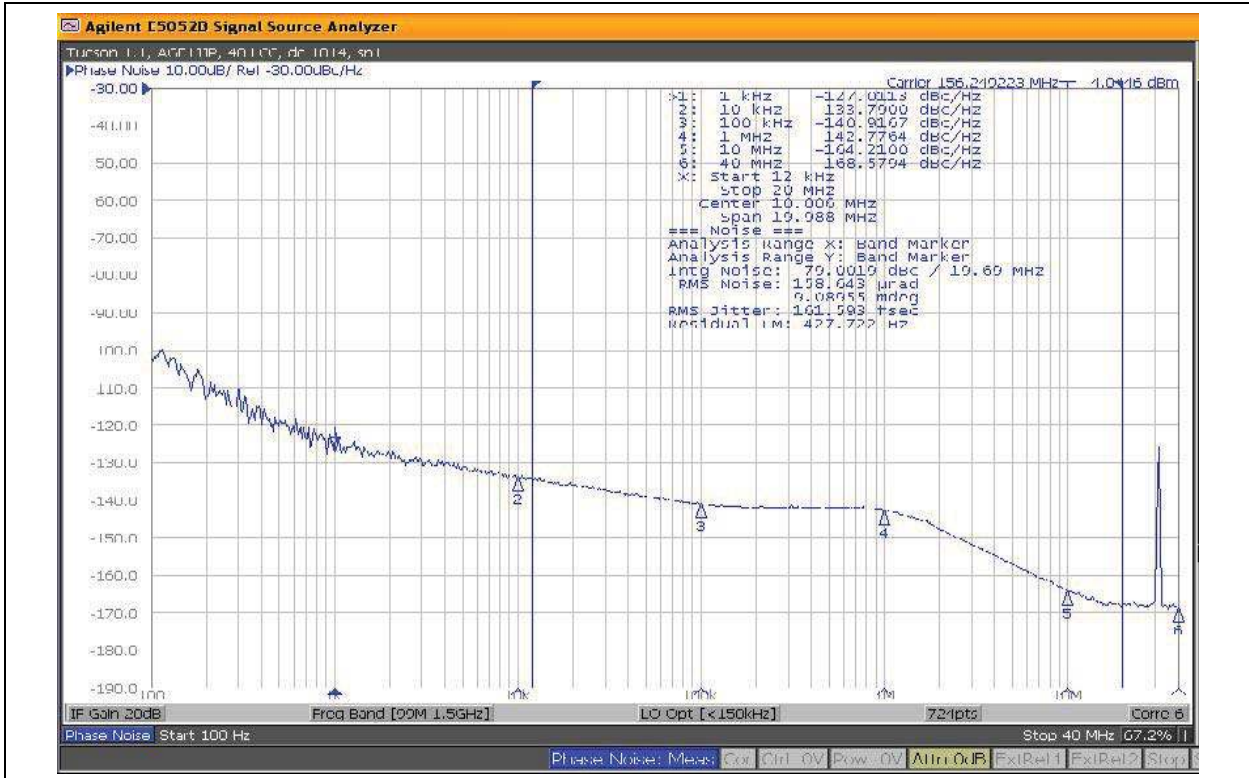


FIGURE 7-2: 156.25 MHz HCSL Output, 12 kHz to 20 MHz, 162 fs

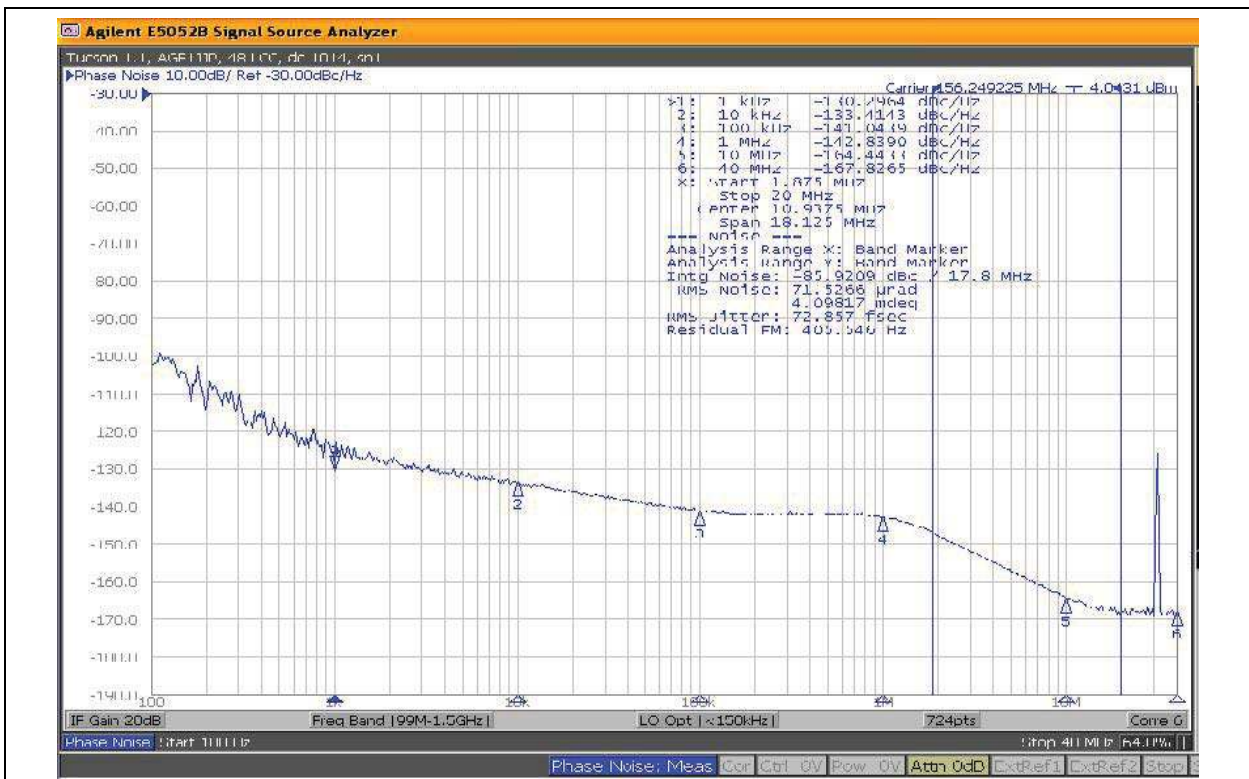


FIGURE 7-3: 156.25 MHz HCSL Output, 1.875 MHz to 20 MHz, 73 fs

MX852B0030

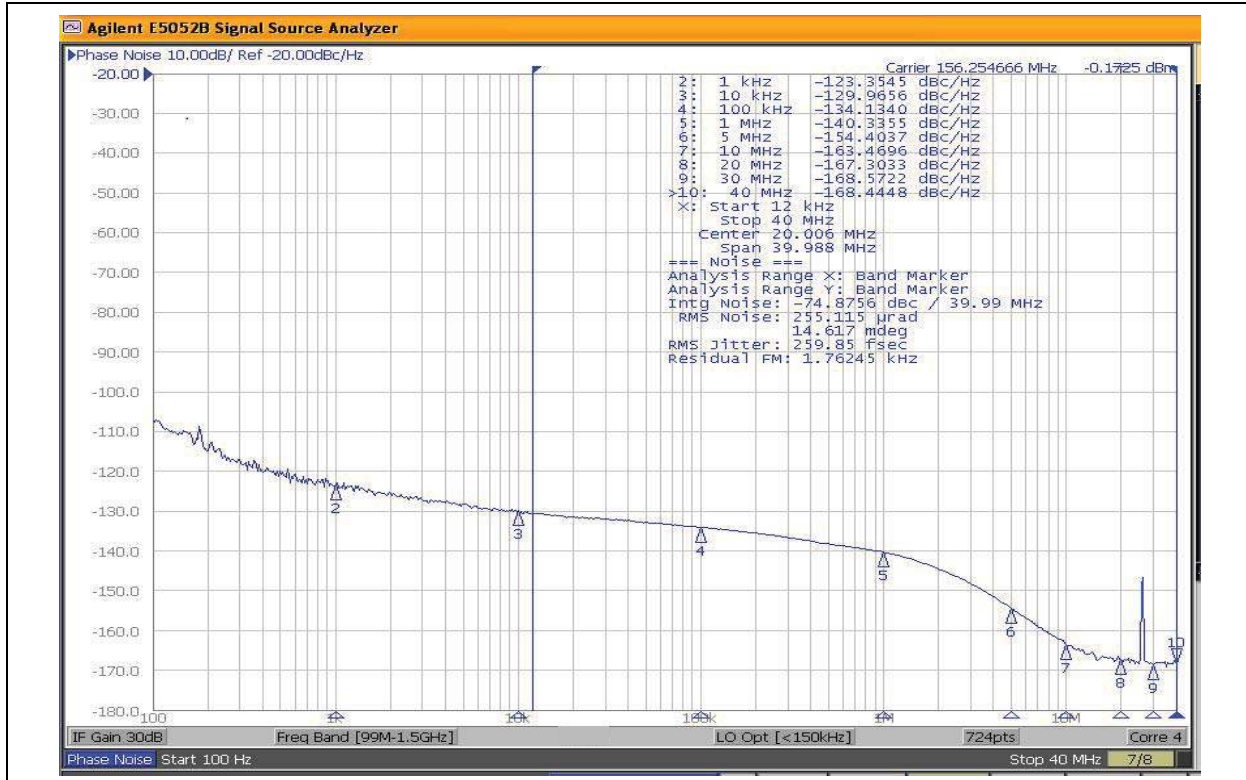


FIGURE 7-4: 156.25 MHz HCSL Output, 12 kHz to 40 MHz, 260 fs

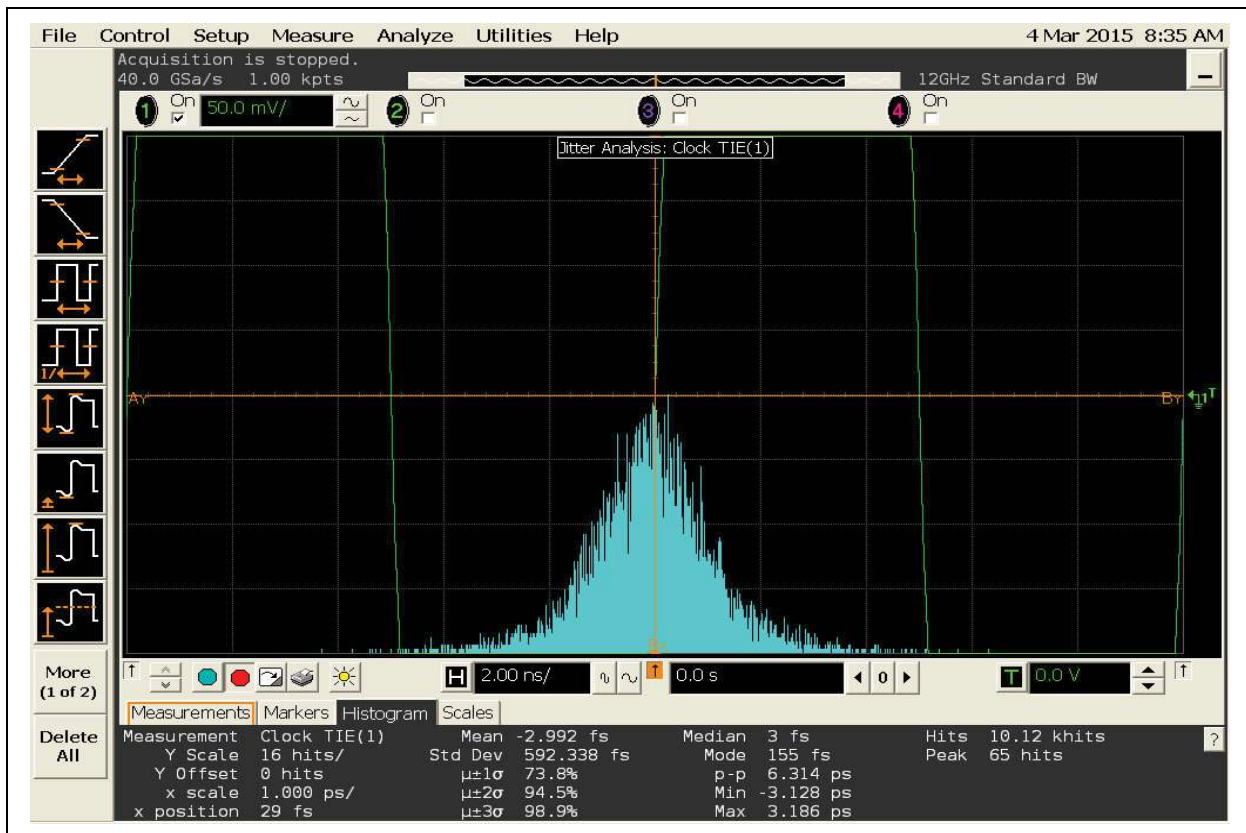
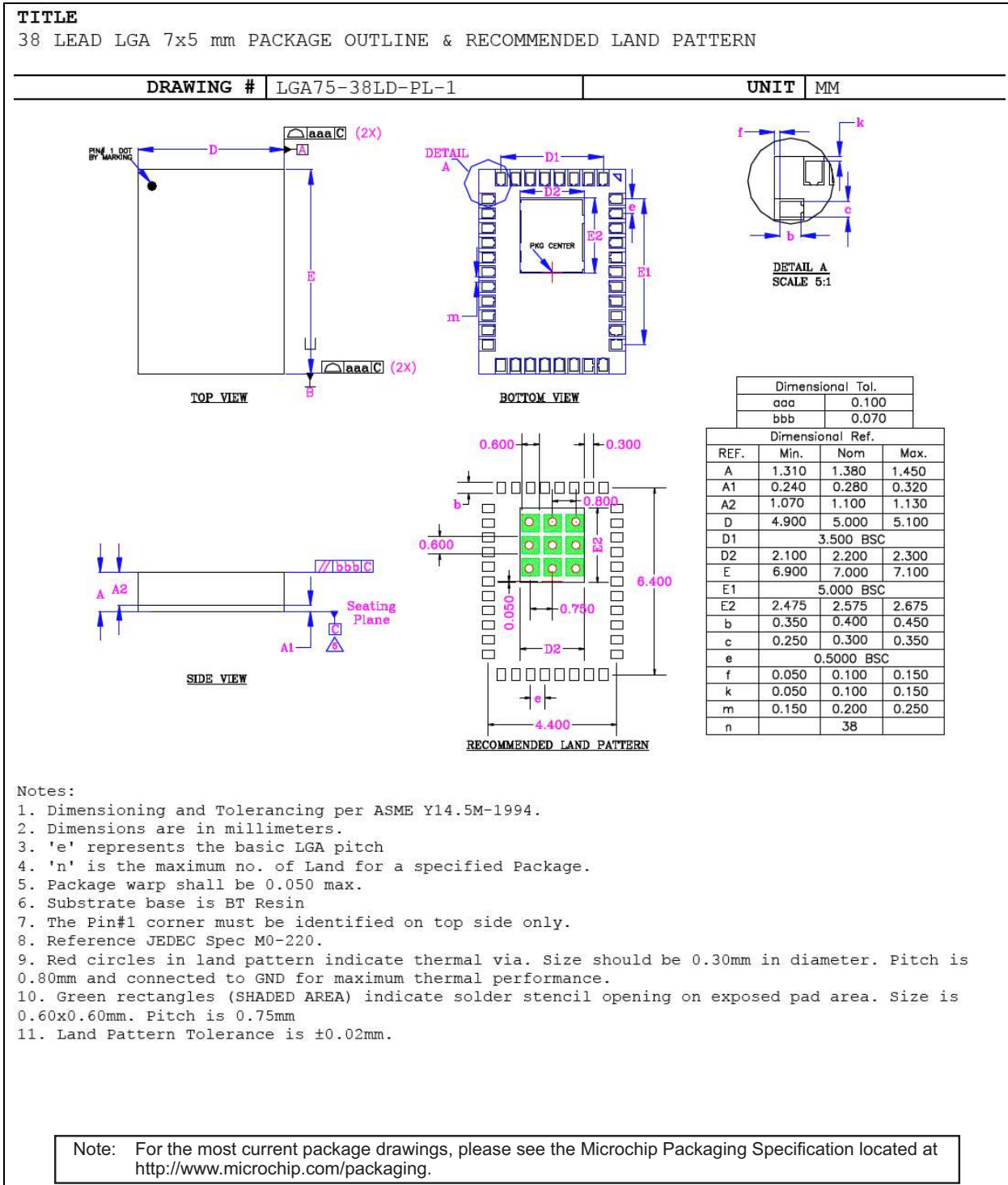


FIGURE 7-5: TIE Jitter (10k Samples).

8.0 PACKAGING INFORMATION

38-Lead LGA Package Outline and Recommended Land Pattern



MX852BB0030

NOTES:

APPENDIX A: REVISION HISTORY

Revision A (October 2018)

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

MX852BB0030

NOTES:

PRODUCT IDENTIFICATION SYSTEM

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

<u>PART NO.</u> - <u>XX</u>	
Device	Media Type
Device: MX852BB0030: Ultra-Low Jitter 5 HCSSL Output Oscillator at 156.25 MHz	
Media Type: (blank)= 43/Tube TR = 1,000/Reel	

Examples:

- a) MX852BB0030: Ultra-Low Jitter 5 HCSSL Output Oscillator at 156.25 MHz, 43/Tube
- b) MX852BB0030-TR: Ultra-Low Jitter 5 HCSSL 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.

MX852BB0030

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.

Information contained in this publication regarding device applications and the like 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. 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 ITS CONDITION, QUALITY, PERFORMANCE, MERCHANTABILITY OR FITNESS FOR PURPOSE. Microchip disclaims all liability arising from this information and its use. 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.

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, KEELoc® 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

The Microchip name and logo, the Microchip logo, AnyRate, AVR, AVR logo, AVR Freaks, BitCloud, chipKIT, chipKIT logo, CryptoMemory, CryptoRF, dsPIC, FlashFlex, flexPWR, Helder, JukeBlox, KeeLoq, Klear, LANCheck, LINK MD, maXStylus, maXTouch, MediaLB, megaAVR, MOST, MOST logo, MPLAB, OptoLyzer, PIC, picoPower, PICSTART, PIC32 logo, Prochip Designer, QTouch, SAM-BA, SpyNIC, SST, SST Logo, SuperFlash, tinyAVR, UNI/O, and XMEGA are registered trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

ClockWorks, The Embedded Control Solutions Company, EtherSynch, Hyper Speed Control, HyperLight Load, IntellIMOS, mTouch, Precision Edge, and Quiet-Wire 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, BodyCom, CodeGuard, CryptoAuthentication, CryptoAutomotive, CryptoCompanion, CryptoController, dsPICDEM, dsPICDEM.net, Dynamic Average Matching, DAM, ECAN, EtherGREEN, In-Circuit Serial Programming, ICSP, INICnet, Inter-Chip Connectivity, JitterBlocker, KlearNet, KlearNet logo, memBrain, Mindi, MiWi, motorBench, MPASM, MPF, MPLAB Certified logo, MPLIB, MPLINK, MultiTRAK, NetDetach, Omniscient Code Generation, PICDEM, PICDEM.net, PICKit, PICtail, PowerSmart, PureSilicon, QMatrix, REAL ICE, Ripple Blocker, SAM-ICE, Serial Quad I/O, SMART-I.S., SQI, SuperSwitcher, SuperSwitcher II, Total Endurance, TSHARC, USBCheck, VariSense, ViewSpan, WiperLock, Wireless DNA, 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.

Silicon Storage Technology is a registered trademark 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.

© 2018, Microchip Technology Incorporated, All Rights Reserved.
ISBN: 978-1-5224-3612-6



MICROCHIP

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