AN577

PIC16C54A EMI Results

Author: Mark Palmer
Ohmmeter Board Setup: Stan D'Souza
Testing: Compatible Electronics

INTRODUCTION

This paper discusses the EMI results of the PIC16C54A. These measurements were taken by an independent consulting firm that specializes in electromagnetic testing. These results are for a specific system design, each design will have its own results.

DEVICES USED

These tests were done on a randomly selected PIC16C54A device, and should be considered as typical results. Initial testing was done on three boards/devices. The device frequency of the boards were, respectively, 32 kHz, 4 MHz, and 20 MHz. As would be expected there was a substantial difference in EMI livels (decrease) at the low frequency as compared to the higher frequencies. The difference between the 4 MHz operation and the 20 MHz operation was marginal. The final testing of the device was done at 4 MHz, and was according to the FCC measurement procedure MP-4.

SYSTEM USED

The PIC16C54A device was tested in the Microchip OHMMETER board. This board is a three layer board, with a ground plane. Power and ground planes greatly help in the compliance of designs to the FCC part 15 subpart B testing. This board had minimal external components, so that the electromagnetic measurements could mostly be attributed to the device and design of the system. To reduce the noise that comes from a power supply, a 10 nF bypass capacitor was attached to the power / ground of the input jack.

EMI TESTING

The testing of electromagnetic noise (EMI) on a system has two types of commonly used testing environments, internal and external. The internal test is performed in a screen room to reduce the amount of stray EMI. The indoor test is useful in determining the source of EMI radiation. The external test is performed outdoors. This places the equipment under test in an environment to measure radiated emissions (EMI). The FCC only requires the outdoor testing of devices. The Equipment Under Test (EUT) was positioned to maximize the emissions.

INTERNAL TESTS

The Equipment Under Test (EUT) was placed on a wooden test bench, inside a screen room, 0.8 meters above the earth ground plane (Figure 1). The EUT was powered through the Line Impedance Stabilization Network (LISN) bonded to the ground plane. The LISN power was filtered and the filter was bonded to the ground plane. The EUT was positioned on the table with the minimum distance from any conductive surface, as specified in MP-4. The excess power cord was wrapped in a figure-8 pattern to form a bundle approximately 8 cm in length. The EUT configuration was set for the highest emission frequency, and data was collected under the program control of the host computer. The spectrum analyzer collected the maximum peak readings over each spectrum. The six highest emission levels and corresponding frequencies were sorted and are listed in Table 1.

TABLE 1: CONDUCTED EMISSIONS RESULTS

Frequency (MHz)	Emission Level dBμV	Emission Level μV	Specification Limit μV
0.5345	33.2	46	250
7.085	33.1	45	250
10.08	33.1	45	250
10.42	33.3	46	250
11.62	33.4	47	250
13.41	33.8	49	250

While in the screen room additional analyses on the device was done. First a local probe was used to test the emission levels around the board and device. There were no measurable emissions at the I/O pins or their corresponding trace lines. Emissions were measured at the jack to the power supply. The power supply and cord were the greatest source of emissions for the EUT. This is due to the power cord being an antenna which emitted the noise from the power supply. Designers should attempt to minimize antennas which emit EMI. Antennas could be the power supply cord, as well as traces on the system board.

Second the PIC16C54A was monitored for susceptibility, following the IEC 801-3 specification. This test was measured from 27 MHz to 500 MHz in 10 kHz steps. The device did not display any signs of susceptibility (Table 2).

EXTERNAL TESTS

The open field site used for radiated emission testing was set up according to FCC bulletin OST 55.

Figure 2 shows the layout of the open field test site. The EUT was mounted on a turntable. The position of the turntable was remotely controlled to determine the highest emission levels. Initial testing was done with a broad band mounted on the antenna mast at a distance of 3 meters. Further investigation was done to determine the EUT positions that produced the maximum level of emissions. The receiving antenna was mounted on the antenna mast. The antenna height was varied to find the highest level of radiated emissions at each frequency. The six highest emission levels and corresponding frequencies were sorted and are listed in Table 3. Figure A-1 and Figure A-2 show the dBμV vs. MHz graphs.

TABLE 2: RADIATED SUSCEPTIBILITY

Frequency (MHz)	SPEC V/M	Threshold V/M	Modulation	Comments
27.0 - 500.0(1)	3.0	> 3.0	80%	No Susceptibility

† Frequency incremented in 10 kHz steps

TABLE 3: RADIATED EMISSIONS RESULTS

Frequency	Meter Reading (dBμV)	Antenna Factor dB	Effective Gain dB	Distribution Factor dB	Corr. Rdg. dBμV/m	Corr. Rdg. μV/m	Spec Limit μV/m
36.01	53.1	11.8	34.0	0	30.9	35	100
40.04	53.0	11.3	34.2	0	30.1	32	100
44.04	56.1	11.1	34.0	0	33.2	46	100
48.04	55.1	11.0	33.7	0	32.4	42	100
64.05	55.2	9.0	33.9	0	30.3	33	100
112.05	56.0	10.6	33.4	0	33.2	46	150

FIGURE 1:

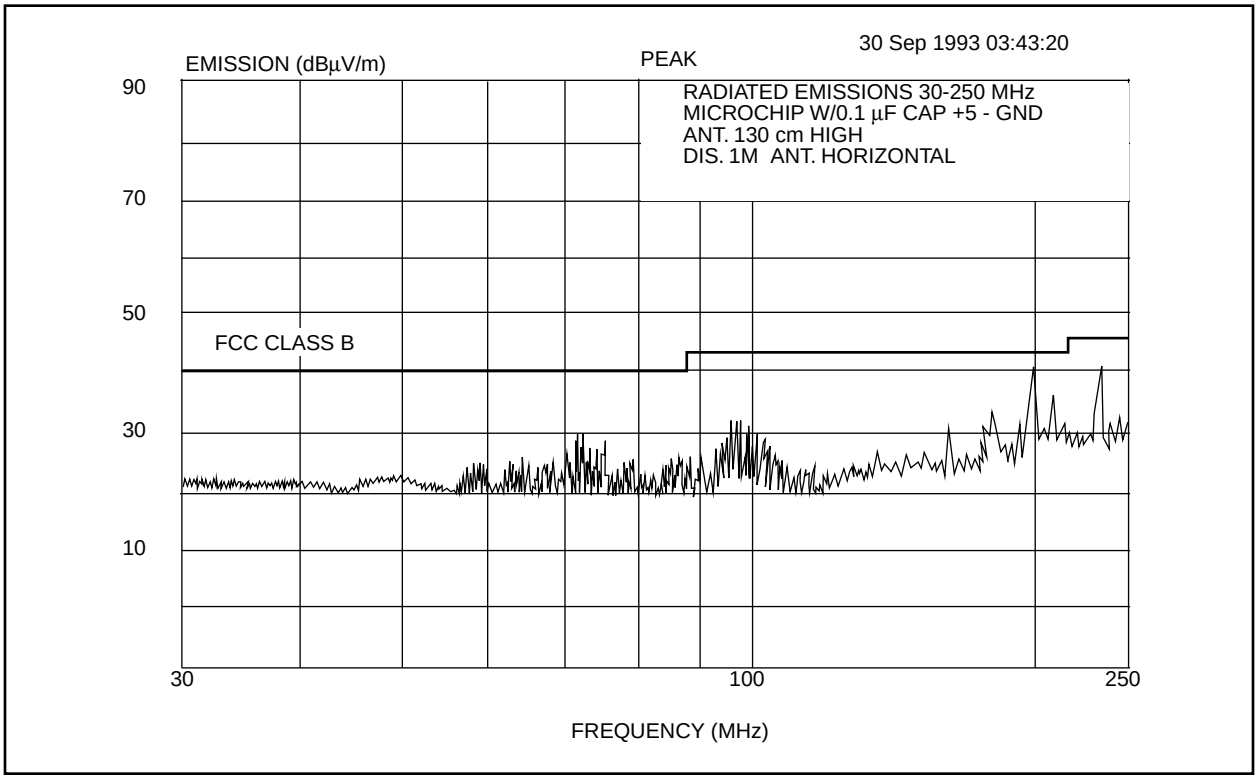
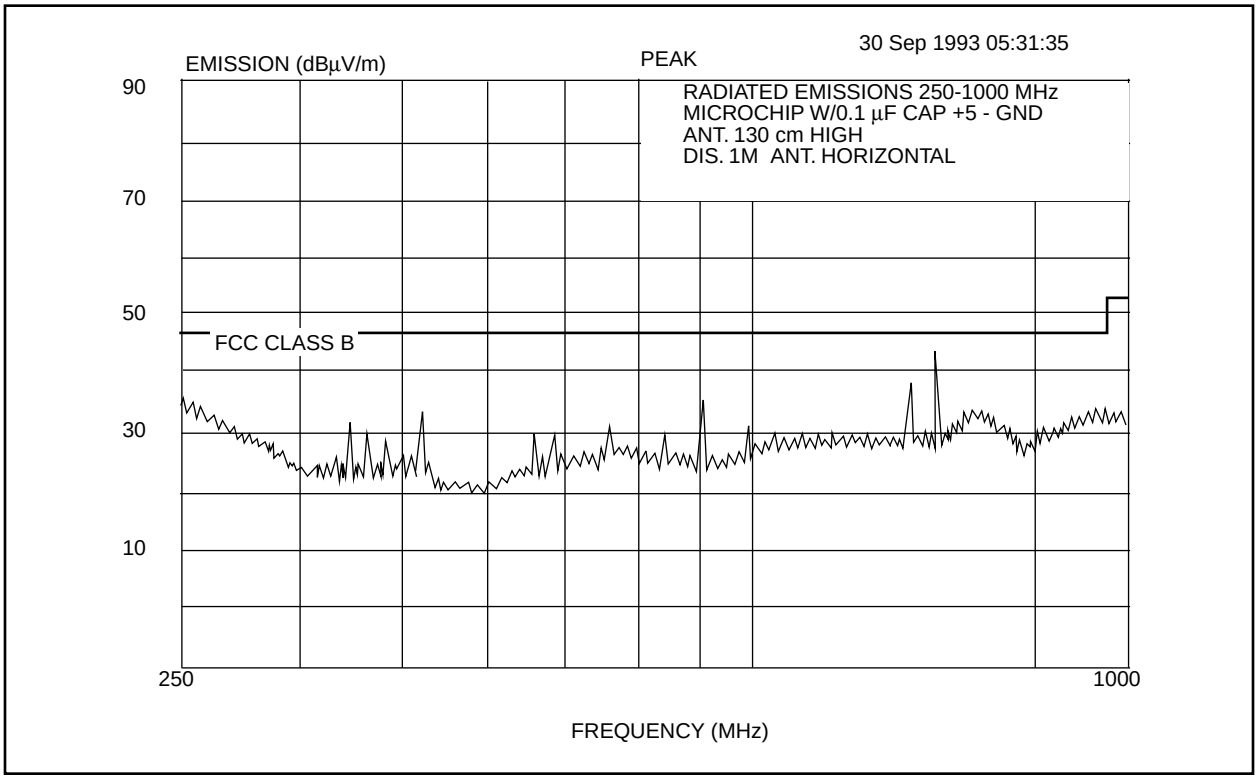


FIGURE 2:



CONCLUSION

The PIC16C54A device can be implemented into system designs that are required to be certified to the FCC Class B specification limits as defined by the FCC Title 47, Part 15 Subpart B and IEC 801-3 susceptibility.

APPENDIX A: TEST SETUPS

FIGURE A-1: CONDUCTED EMISSIONS TEST SETUP FOR SITE "A"

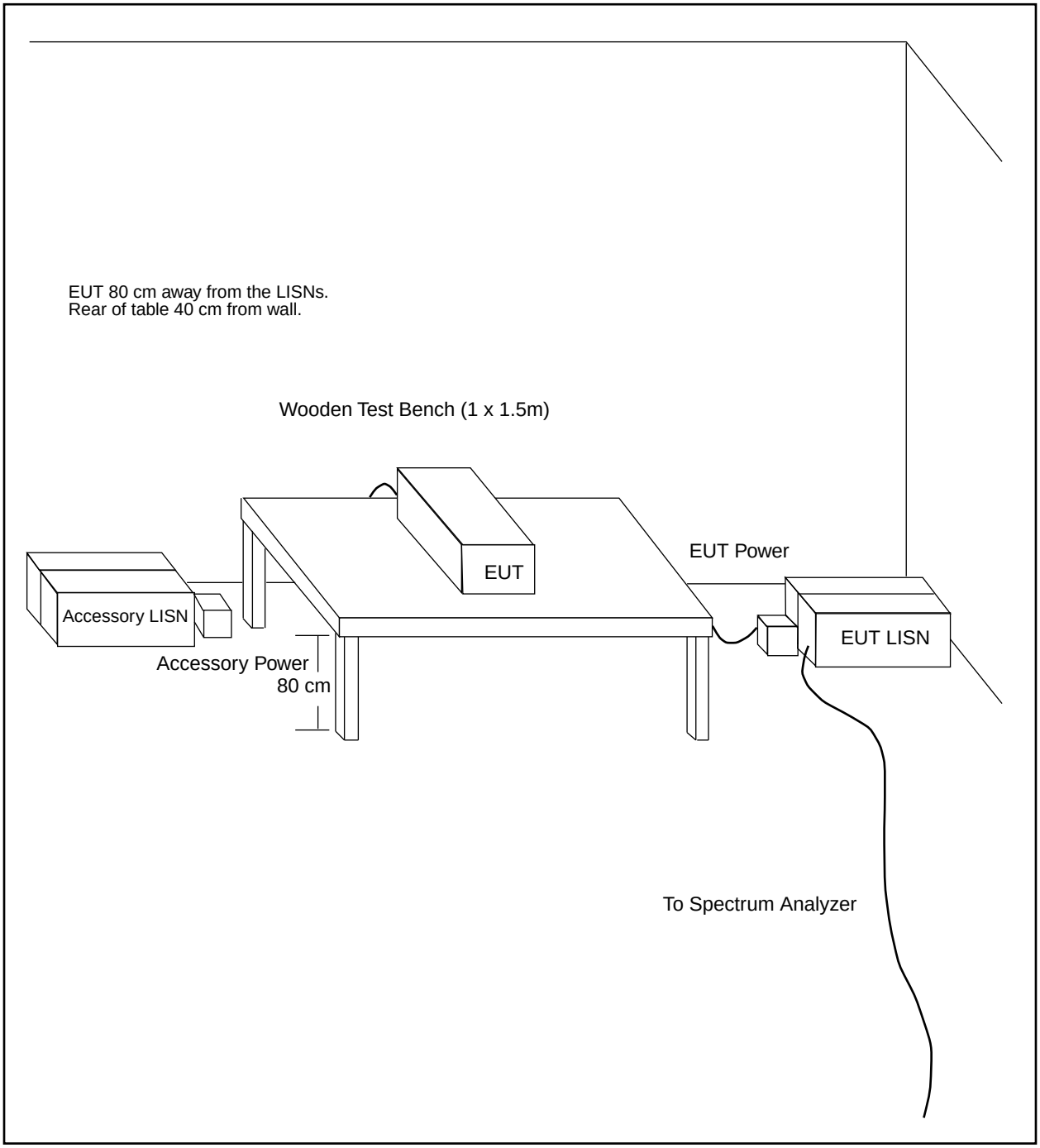
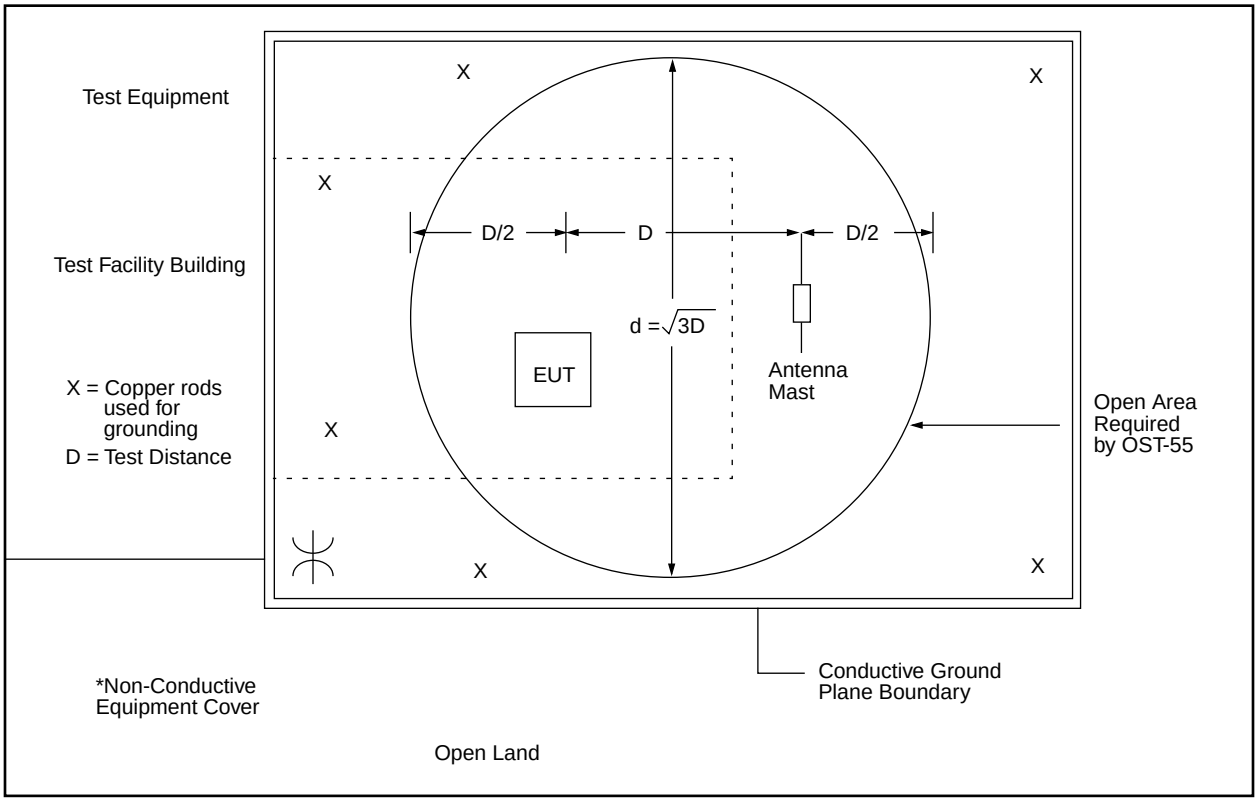


FIGURE A-2: RADIATED EMISSIONS TEST SETUP FOR SITE "B"



NOTES:

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2355 West Chandler Blvd.
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Detroit
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Farmington Hills, MI 48334
Tel: 248-538-2250 Fax: 248-538-2260

Kokomo
2767 S. Albright Road
Kokomo, Indiana 46902
Tel: 765-864-8360 Fax: 765-864-8387

Los Angeles
18201 Von Karman, Suite 1090
Irvine, CA 92612
Tel: 949-263-1888 Fax: 949-263-1338

New York
150 Motor Parkway, Suite 202
Hauppauge, NY 11788
Tel: 631-273-5305 Fax: 631-273-5335

San Jose
Microchip Technology Inc.
2107 North First Street, Suite 590
San Jose, CA 95131
Tel: 408-436-7950 Fax: 408-436-7955

Toronto
6285 Northam Drive, Suite 108
Mississauga, Ontario L4V 1X5, Canada
Tel: 905-673-0699 Fax: 905-673-6509

ASIA/PACIFIC

Australia
Microchip Technology Australia Pty Ltd
Suite 22, 41 Rawson Street
Epping 2121, NSW
Australia
Tel: 61-2-9868-6733 Fax: 61-2-9868-6755

China - Beijing
Microchip Technology Consulting (Shanghai) Co., Ltd., Beijing Liaison Office
Unit 915
Bei Hai Wan Tai Bldg.
No. 6 Chaoyangmen Beidajie
Beijing, 100027, No. China
Tel: 86-10-85282100 Fax: 86-10-85282104

China - Chengdu
Microchip Technology Consulting (Shanghai) Co., Ltd., Chengdu Liaison Office
Rm. 2401, 24th Floor,
Ming Xing Financial Tower
No. 88 TIDU Street
Chengdu 610016, China
Tel: 86-28-6766200 Fax: 86-28-6766599

China - Fuzhou
Microchip Technology Consulting (Shanghai) Co., Ltd., Fuzhou Liaison Office
Unit 28F, World Trade Plaza
No. 71 Wusi Road
Fuzhou 350001, China
Tel: 86-591-7503506 Fax: 86-591-7503521

China - Shanghai
Microchip Technology Consulting (Shanghai) Co., Ltd.
Room 701, Bldg. B
Far East International Plaza
No. 317 Xian Xia Road
Shanghai, 200051
Tel: 86-21-6275-5700 Fax: 86-21-6275-5060

China - Shenzhen
Microchip Technology Consulting (Shanghai) Co., Ltd., Shenzhen Liaison Office
Rm. 1315, 13/F, Shenzhen Kerry Centre,
Renminnan Lu
Shenzhen 518001, China
Tel: 86-755-2350361 Fax: 86-755-2366086

Hong Kong
Microchip Technology Hongkong Ltd.
Unit 901-6, Tower 2, Metroplaza
223 Hing Fong Road
Kwai Fong, N.T., Hong Kong
Tel: 852-2401-1200 Fax: 852-2401-3431

India
Microchip Technology Inc.
India Liaison Office
Divyasree Chambers
1 Floor, Wing A (A3/A4)
No. 11, O'Shaugnessey Road
Bangalore, 560 025, India
Tel: 91-80-2290061 Fax: 91-80-2290062

Japan
Microchip Technology Japan K.K.
Benex S-1 6F
3-18-20, Shinyokohama
Kohoku-Ku, Yokohama-shi
Kanagawa, 222-0033, Japan
Tel: 81-45-471- 6166 Fax: 81-45-471-6122

Korea
Microchip Technology Korea
168-1, Youngbo Bldg. 3 Floor
Samsung-Dong, Kangnam-Ku
Seoul, Korea 135-882
Tel: 82-2-554-7200 Fax: 82-2-558-5934

Singapore
Microchip Technology Singapore Pte Ltd.
200 Middle Road
#07-02 Prime Centre
Singapore, 188980
Tel: 65-334-8870 Fax: 65-334-8850

Taiwan
Microchip Technology Taiwan
11F-3, No. 207
Tung Hua North Road
Taipei, 105, Taiwan
Tel: 886-2-2717-7175 Fax: 886-2-2545-0139

EUROPE

Denmark
Microchip Technology Nordic ApS
Regus Business Centre
Lautrup hoj 1-3
Ballerup DK-2750 Denmark
Tel: 45 4420 9895 Fax: 45 4420 9910

France
Microchip Technology SARL
Parc d'Activite du Moulin de Massy
43 Rue du Saule Trapu
Batiment A - ler Etage
91300 Massy, France
Tel: 33-1-69-53-63-20 Fax: 33-1-69-30-90-79

Germany
Microchip Technology GmbH
Gustav-Heinemann Ring 125
D-81739 Munich, Germany
Tel: 49-89-627-144 0 Fax: 49-89-627-144-44

Italy
Microchip Technology SRL
Centro Direzionale Colleoni
Palazzo Taurus 1 V. Le Colleoni 1
20041 Agrate Brianza
Milan, Italy
Tel: 39-039-65791-1 Fax: 39-039-6899883

United Kingdom
Arizona Microchip Technology Ltd.
505 Eskdale Road
Winnersh Triangle
Wokingham
Berkshire, England RG41 5TU
Tel: 44 118 921 5869 Fax: 44-118 921-5820

01/18/02