1500 Watt Low Capacitance Surface Mount Transient Voltage Suppressor

MSMCGLCE6.5A – MXLSMCGLCE170Ae3, MSMCJLCE6.5A – MXLSMCJLCE170Ae3

Product Overview

This high-reliability surface mount Transient Voltage Suppressor (TVS) product family includes a rectifier diode in series with and in the opposite direction to the primary TVS protection diode. The circuit being protected sees only the rectifier diode's low 100 pF capacitance. They are available in either a DO-215AB (gull-wing) or DO-214AB (J-bend) package, and RoHS compliant versions are available. The low capacitance of these TVS devices allows them to be applied to the protection of high-frequency signal and communication lines in inductive switching environments or systems exposed to the secondary effects of lightning per IEC61000-4-5, as well as RTCA/DO-160G or ARINC 429 for airborne avionics. They also protect from ESD and EFT per IEC61000-4-2 and IEC61000-4-4. If bipolar transient capability is required, two of these low capacitance TVS devices may be used in parallel and opposite directions (anti-parallel) for complete AC protection (Figure 5-3).

Features

- All devices are 100% surge tested.
- Low capacitance of 100 pF or less
- 3σ (sigma) lot norm screening performed on standby current (I_D) for all M prefix devices
- Molding compound flammability rating: UL94V-O
- Unidirectional versions available only
- Two different terminations available in C-bend (modified J-bend with DO-214AB) or Gull-wing (DO-215AB)
- Moisture classification is Level 1 with no dry pack required per IPC/JEDEC J-STD-020B for all M prefix devices
- Suppress transients up to 1,500W at 10/1000 μs (see Figure 4-1)
- Enhanced reliability screening options with M prefix are available in reference to MIL-PRF-19500. Refer to High Reliability Non-Hermetic Products Portfolio for more details on the screening options.
  (See Part Nomenclature for all available options.)
- RoHS compliant versions available
- Axial-lead equivalent packages for thru-hole mounting are available as MLCE6.5 to MLCE170Ae3 with 1500W rating (contact Microchip for other surface mount options.)

Figure 1. DO-215AB (SMCG) Package

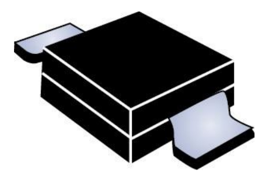


Figure 2. DO-214AB (SMCJ) Package

All SMC series are equivalent to prior SMM package identifications.

Also available in:

Commercial Grade: SMCG(J)LCE6.5 – SMCG(J)LCE170Ae3

Case 1 Package (Axial-Leaded): MLCE6.5 – MLCE170Ae3

Applications/Benefits

- Available in working stand-off voltage range of 6.5 to 170V
- Low capacitance for high frequency data line protection to 1 MHz
- Protection for aircraft fast data rate lines up to level 5 waveform 4 and level 2 waveform 5A in RTCA/DO-160G (also see MicroNote 130) and ARINC 429 with bit rates of 100 kb/s (per ARINC 429, Part 1, par 2.4.1.1)
- IEC61000-4-2 ESD 15 kV (air), 8 kV (contact)
- IEC61000-4-5 (lightning) as further detailed in LCE6.5 thru LCE170A data sheet
- T1/E1 line cards
- Base stations, WAN and XDSL interfaces
- CSU/DSU equipment

Table of Contents

1. Maximum Ratings

Table 1-1. Maximum Ratings at 25 °C Unless Otherwise Stated

Parameters/Test Conditions		Symbol	Value	Unit
Junction and storage temperature		T_J and T_{STG}	–65 to +150	°C
Thermal resistance junction-to-lead[1]		$R_{\Theta JL}$	20	°C/W
Peak pulse power dissipation at 25 °C (at 10/1000 μs, see Figure 4-1, Figure 4-2, and Figure 4-3)[2]		P_{PP}	1500	W
Impulse repetition rate (duty factor)		df	0.01 or less	%
$t_{clamping}$ (0 volts to $V_{(BR)}$ min.)		$t_{clamping}$	< $5x10^{-9}$	s
Rated average power dissipation	T_L = +50 °C T_A = 25 °C	$P_{M(AV)}$	5.0 1.5	W
Solder temperature at 10 s		T_{SP}	260	°C

Notes:

1. Typical junction to lead (tab) at mounting plane
2. With a repetition rate of 0.01% or less. When pulse testing, do not pulse in opposite direction (see Application Schematics herein and Figure 5-2 and Figure 5-3 for further protection in both directions.)

1.1 Mechanical and Packaging

- Case: Void-free transfer molded thermosetting epoxy body meeting UL94V-0
- Terminals: Tin-lead or RoHS compliant annealed matte-tin plating. Solderable to MIL-STD-750, method 2026
- Marking: Part number with abbreviated prefix (MCLC6.5A, MCLC6.5Ae3, MCLC33, MCLC33e3, etc.)
- Polarity: Cathode indicated by band
- Tape and reel option: Standard per EIA-481-B with 16 mm tape (add “TR” suffix to part number). Consult factory for quantities.
- Weight: Approximately 0.25 grams
- See Package Dimensions

2. Part Nomenclature

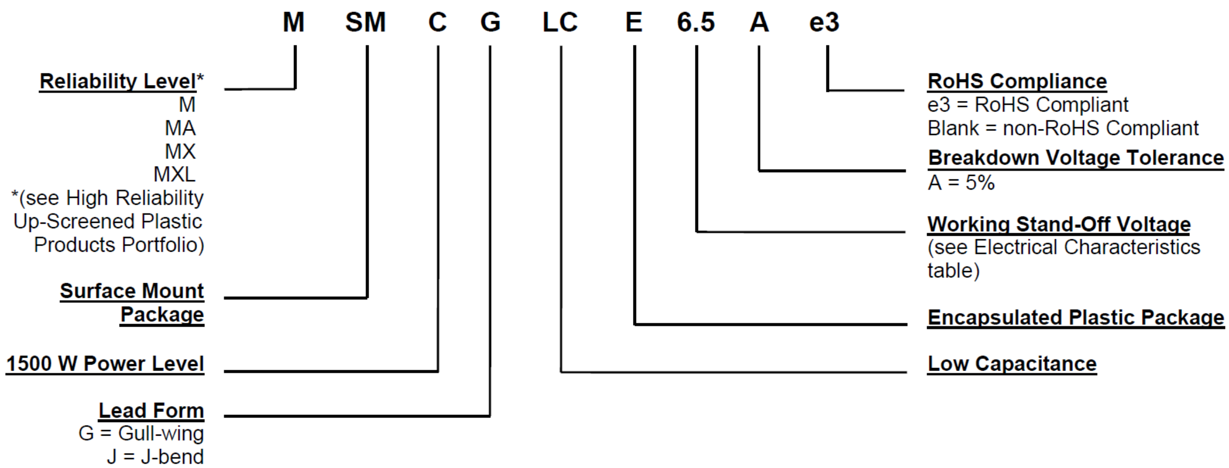


Figure 2-1. Part Nomenclature

2.1 Symbols and Definitions

Table 2-1. Symbols and Definitions

Symbol	Definition
$\alpha_{V(BR)}$	Temperature coefficient of breakdown voltage: The change in breakdown voltage divided by the change in temperature that caused it expressed in %/°C or mV/°C.
C_T	Total capacitance: The total small signal capacitance between the diode terminals of a complete device.
$I_{(BR)}$	Breakdown current: The current used for measuring Breakdown Voltage $V_{(BR)}$.
I_D	Standby current: The current through the device at working standoff voltage.
I_{IB}	Inverse blocking leakage current: The current through a unidirectional-blocking low capacitance device at working inverse blacking voltage (V_{WIB})
I_{PP}	Peak impulse current: The peak current during an impulse.
P_{PP}	Peak pulse power: The peak power that can be applied for a specific pulse width and waveform. The product of I_{PP} and V_C.
$V_{(BR)}$	Breakdown voltage: The voltage across the device at a specified current $I_{(BR)}$ in the breakdown region.
V_C	Clamping voltage: The voltage across the device in a region of low differential resistance during the application of an impulse current (I_{PP}) for a specified waveform.
V_{PIB}	Peak inverse blocking voltage: Minimum breakdown voltage of the series low capacitance rectifier.
V_{WIB}	Working inverse blocking voltage: The maximum-rated value of dc or peak blocking voltage that may be applied to a unidirectional-blocking low-capacitance diode in the inverse direction. Above this rated voltage, the diode is not to be surge or impulse tested for any reason.
V_{WM}	Working standoff voltage: The maximum-rated value of DC or repetitive peak positive cathode-to-anode voltage that may be continuously applied over the standard operating temperature.

3. Electrical Characteristics

Table 3-1. Electrical Characteristics at 25 °C Unless Otherwise Stated

Part Number	Working Standoff Voltage V_{WM} Volts	Breakdown Voltage $V_{(BR)}$ at $I_{(BR)}$ Volts			Maximum Standby Current at V_{WM} I_D µA	Maximum Clamping Voltage at I_{PP} V_C Volts	Maximum Peak Pulse Current I_{PP} at 10/1000 Amps	Working Inverse Blocking Voltage V_{WIB} Volts	Peak Inverse Blocking Voltage V_{PIB} Volts
		Min.	Max.	mA					
MSMCxLCE6.5A	6.5	7.22	7.98	10	1000	11.2	100	75	100
MSMCxLCE7.0A	7.0	7.78	8.60	10	500	12.0	100	75	100
MSMCxLCE7.5A	7.5	8.33	10.2	10	250	12.9	100	75	100
MSMCxLCE8.0A	8.0	8.89	9.83	1	100	13.6	100	75	100
MSMCxLCE8.5A	8.5	9.44	10.4	1	50	14.4	100	75	100
MSMCxLCE9.0A	9.0	10.0	11.1	1	10	15.4	97	75	100
MSMCxLCE10A	10	11.1	12.3	1	5	17.0	88	75	100
MSMCxLCE11A	11	12.2	13.5	1	5	18.2	82	75	100
MSMCxLCE12A	12	13.3	14.7	1	5	19.9	75	75	100
MSMCxLCE13A	13	14.4	15.9	1	5	21.5	70	75	100
MSMCxLCE14A	14	15.6	17.2	1	5	23.2	65	75	100
MSMCxLCE15A	15	16.7	18.5	1	5	24.4	61	75	100
MSMCxLCE16A	16	17.8	19.7	1	5	26.0	57	75	100
MSMCxLCE17A	17	18.9	20.9	1	5	27.6	54	75	100
MSMCxLCE18A	18	20.0	22.1	1	5	29.2	51	75	100
MSMCxLCE20A	20	22.2	24.5	1	5	32.4	46	75	100
MSMCxLCE22A	22	24.4	26.9	1	5	35.5	42	75	100
MSMCxLCE24A	24	26.7	29.5	1	5	38.9	39	75	100
MSMCxLCE26A	26	28.9	31.9	1	5	42.1	36	75	100
MSMCxLCE28A	28	31.1	34.4	1	5	45.5	33	75	100
MSMCxLCE30A	30	33.3	36.8	1	5	48.4	31	75	100
MSMCxLCE33A	33	36.7	40.6	1	5	53.3	28.1	75	100
MSMCxLCE36A	36	40.0	44.2	1	5	58.1	25.8	75	100
MSMCxLCE40A	40	44.4	49.1	1	5	64.5	23.3	75	100
MSMCxLCE43A	43	47.8	52.8	1	5	69.4	21.6	150	200
MSMCxLCE45A	45	50.0	55.3	1	5	72.7	20.6	150	200
MSMCxLCE48A	48	53.3	58.9	1	5	77.4	19.4	150	200
MSMCxLCE51A	51	56.7	62.7	1	5	82.4	18.2	150	200
MSMCxLCE54A	54	60.0	66.3	1	5	87.1	17.2	150	200
MSMCxLCE58A	58	64.4	71.2	1	5	93.6	16.0	150	200
MSMCxLCE60A	60	66.7	73.7	1	5	96.8	15.5	150	200
MSMCxLCE64A	64	71.1	78.6	1	5	103	14.6	150	200
MSMCxLCE70A	70	77.8	85.0	1	5	113	13.3	150	200
MSMCxLCE75A	75	83.3	92.1	1	5	121	12.4	150	200
MSMCxLCE80A	80	88.7	98.0	1	5	129	11.6	150	200
MSMCxLCE90A	90	100	111	1	5	146	10.3	300	200

...........continued

Part Number	Working Standoff Voltage V_{WM} Volts	Breakdown Voltage $V_{(BR)}$ at $I_{(BR)}$ Volts			Maximum Standby Current at V_{WM} I_D µA	Maximum Clamping Voltage at I_{PP} V_C Volts	Maximum Peak Pulse Current I_{PP} at 10/1000 Amps	Working Inverse Blocking Voltage V_{WIB} Volts	Peak Inverse Blocking Voltage V_{PIB} Volts
		Min.	Max.	mA					
MSMCxLCE100A	100	111	123	1	5	162	9.3	300	200
MSMCxLCE110A	110	122	135	1	5	178	8.4	300	400
MSMCxLCE120A	120	133	147	1	5	193	7.8	300	400
MSMCxLCE130A	130	144	159	1	5	209	7.2	300	400
MSMCxLCE150A	150	167	185	1	5	243	6.2	300	400
MSMCxLCE160A	160	178	197	1	5	259	5.8	300	400
MSMCxLCE170A	170	189	209	1	5	275	5.4	300	400

Notes:

1. Normal selection criteria for TVS devices is by working standoff voltage (V_{WM}) and should be equal or greater than DC or continuous peak operating voltage.
2. TVS devices are tested to maximum peak pulse current (I_{PP}) with clamping voltage monitored. This surge capability is one of the most significant electrical characteristics of the device and should be considered as part of customer quality inspections. Test in TVS avalanche direction. Do not pulse in “forward” direction. See Application Schematics.
3. Maximum capacitance of MLCE series at 0 Volts:
   - is 100 pF for V_{WM} 6.5 to 58V
   - is 90 pF for V_{WM} 60 to 170V
4. V_{WIB} is at Inverse Blocking Leakage Current (I_{IB}) of 10 µA.

4. Graphs

Figure 4-1. Peak Pulse Power Vs. Pulse Time

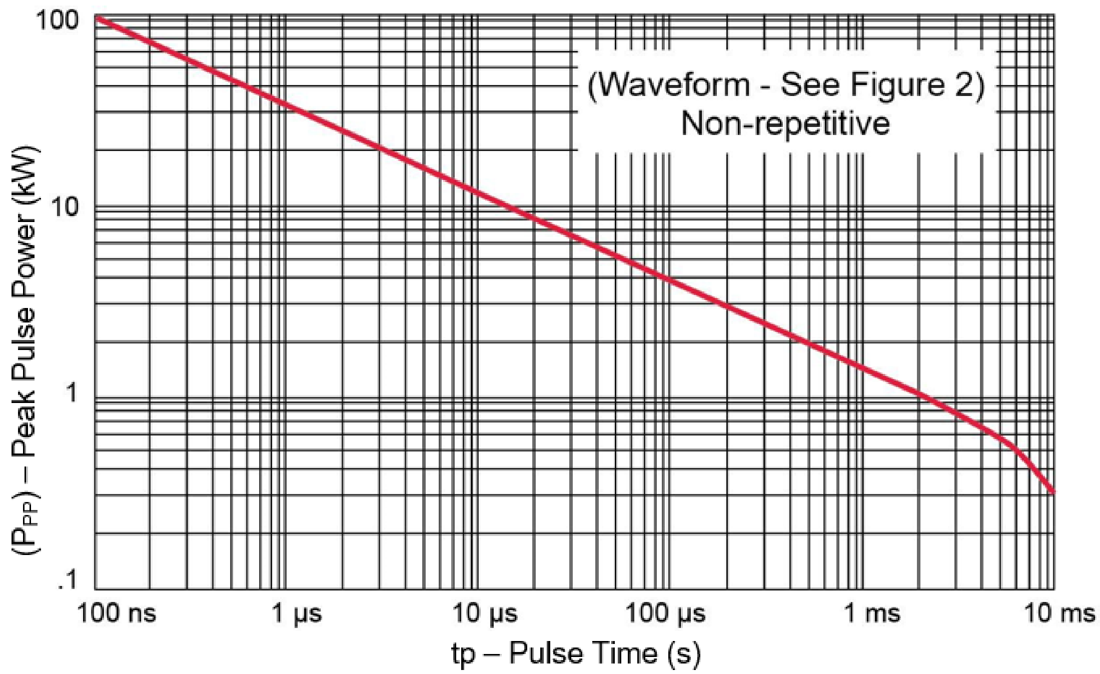


Figure 4-2. Pulse Waveform

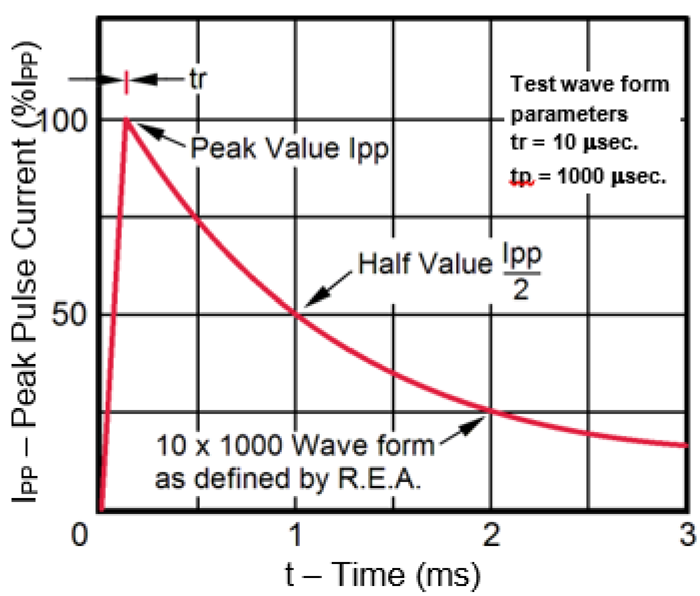
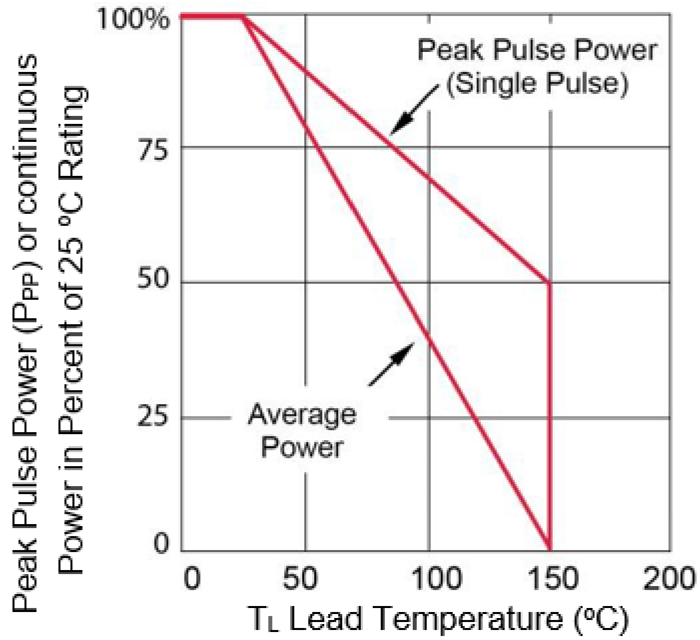


Figure 4-3. Derating Curve



5. Application Schematics

The TVS low capacitance device configuration is shown in Figure 5-1. As a further option for unidirectional applications, an additional low capacitance rectifier diode may be used in parallel in the same polarity direction as the TVS as shown in Figure 5-2. In applications where random high voltage transients occur, this will prevent reverse transients from damaging the internal low capacitance rectifier diode and also provide a low voltage conducting direction. The added rectifier diode should be of similar low capacitance and also have a higher reverse voltage rating than the TVS clamping voltage V_C. The Microchip recommended rectifier part number for the application in Figure 5-2 is the “SMBJLCR80” or “SMBGLCR80” depending on the terminal configuration desired. If using two (2) low capacitance TVS devices in anti-parallel for bidirectional applications, this added protective feature for both directions (including the reverse of each rectifier diode) is inherently provided in Figure 5-3. The unidirectional and bidirectional configurations in Figure 5-2 and Figure 5-3 will both result in twice the capacitance of Figure 5-1.

Figure 5-1. TVS With Internal Low Capacitance Rectifier Diode

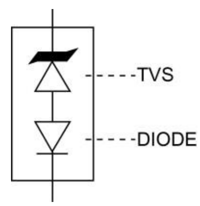


Figure 5-2. Optional Unidirectional Configuration (TVS and Separate Rectifier Diode in Parallel)

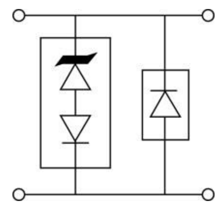
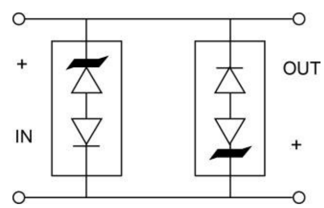
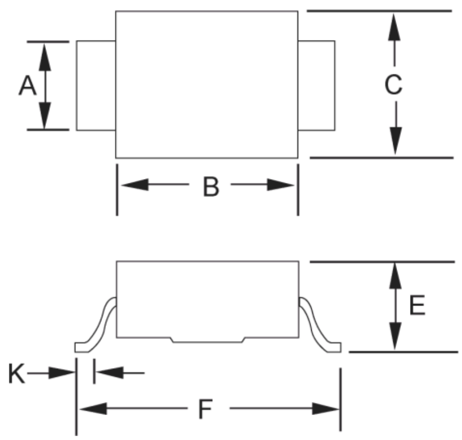


Figure 5-3. Optional Bidirectional Configuration (Two TVS Devices in Anti-Parallel)



6. Package Dimensions

Figure 6-1. SMCG (DO-215AB)

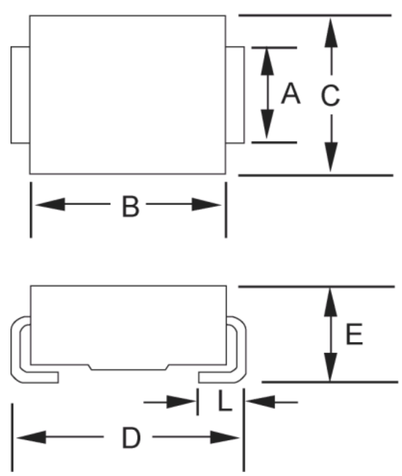


Ltr	Dimensions			
	Inch		Millimeters	
	Min.	Max.	Min.	Max.
A	0.115	0.121	2.92	3.07
B	0.260	0.280	6.60	7.11
C	0.220	0.245	5.59	6.22
E[1]	0.077	0.110	1.95	2.80
F	0.380	0.400	9.65	10.16
K	0.025	0.040	0.635	1.016

Note:

1. Dimension “E” exceeds the JEDEC outline as shown. Typical stand-off height: 0.004”–0.008” (0.1 mm – 0.2 mm).

Figure 6-2. SMCJ (DO-214AB)



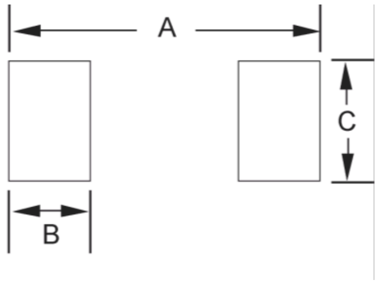
Ltr	Dimensions			
	Inch		Millimeters	
	Min.	Max.	Min.	Max.
A	0.115	0.121	2.92	3.07
B	0.260	0.280	6.60	7.11
C	0.220	0.245	5.59	6.22
D	0.305	0.320	7.75	8.13
E	0.077	0.110	1.95	2.80
L	0.030	0.060	0.760	1.52

Note:

1. Dimension “E” exceeds the JEDEC outline in height as shown. Typical stand-off height: 0.004”–0.008” (0.1 mm – 0.2 mm).

7. Pad Layout

Figure 7-1. Pad Layout



SMCG (DO-215AB)		
Ltr	**Inch**	**Millimeters**
A	0.510	12.95
B	0.110	2.79
C	0.150	3.81

SMCJ (DO-214AB)		
Ltr	**Inch**	**Millimeters**
A	0.390	9.90
B	0.110	2.79
C	0.150	3.81

8. 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.

Revision	Date	Description
B	02/2024	Updated Table 2-1 and Table 3-1.
A	10/2023	Initial revision.

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 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

ISBN: 978-1-6683-3982-4

Quality Management System

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

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:
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: 45-4485-5910
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