MIC94300

200 mA Switch with Ripple Blocker™ Technology

Features

- 1.8V to 3.6V Input Voltage Range
- Active Noise Rejection over a Wide Frequency Band
  - >60 dB from 40 kHz to 5 MHz
- Rated to 200 mA Output Current
- Current-Limit and Thermal-Limit Protected
- 1.2 mm x 1.6 mm, 4-lead UDFN
- Logic-Controlled Enable Pin
- −40°C to +125°C Junction Temperature Range

Applications

- Smart Phones
- Tablet PC/Notebooks and Webcams
- Digital Still and Video Cameras
- Video Conferencing
- Barcode Scanners
- Global Positioning Systems
- Automotive and Industrial Applications

General Description

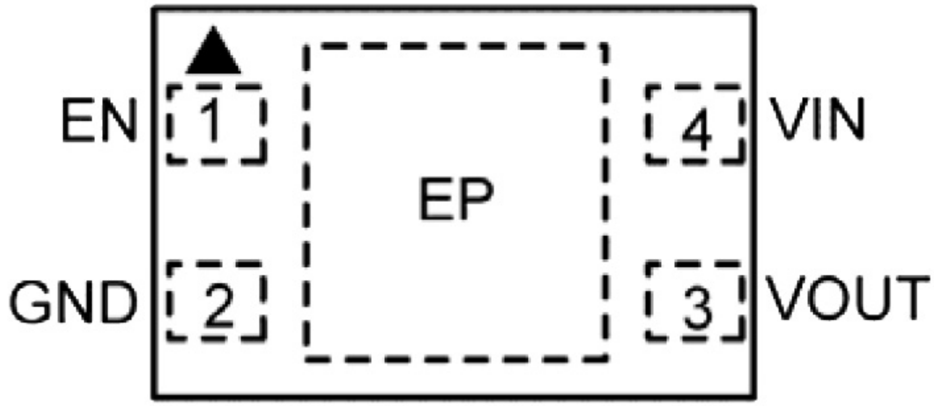
The MIC94300 is an integrated load switch that incorporates Microchip's Ripple Blocker™ active filter technology. The MIC94300 provides high-frequency ripple attenuation (switching noise rejection) for applications where a switching noise cannot be tolerated by sensitive downstream circuits such as in RF applications. A low-voltage logic enable pin disconnects the pass element and places the MIC94300 into a low current-shutdown state when disabled.

The MIC94300 operates from an input voltage of 1.8V to 3.6V, allowing true load switching of low-voltage power rails in any electronic device. The output voltage (V_{OUT}) is set at a fixed drop (typically 170 mV) from the input voltage ($V_{OUT} = V_{IN} - 170$ mV). This maintains high efficiency independent of given load conditions and currents.

Packaged in a 4-lead 1.2 mm x 1.6 mm ultra-thin dual flatpack no-leads (UDFN) package, the MIC94300 has a junction operating temperature range of −40°C to +125°C.

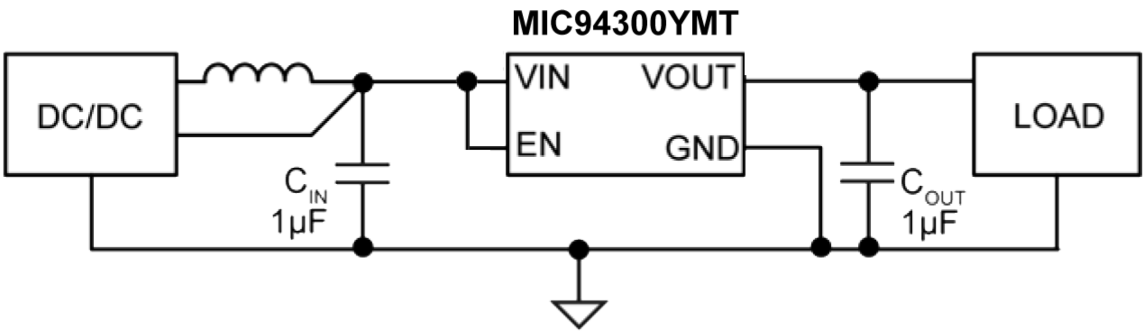
Package Types

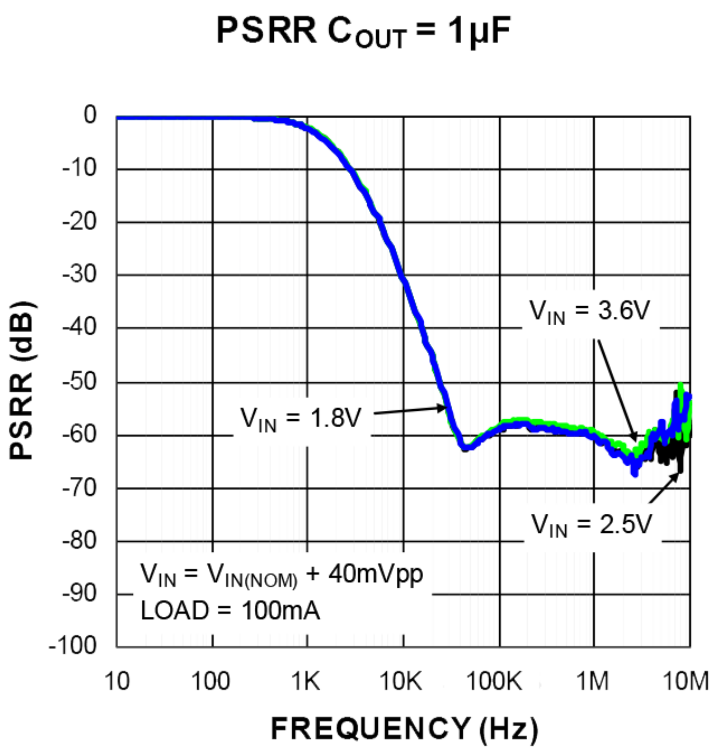
MIC94300
4-Lead UDFN
(Top View)



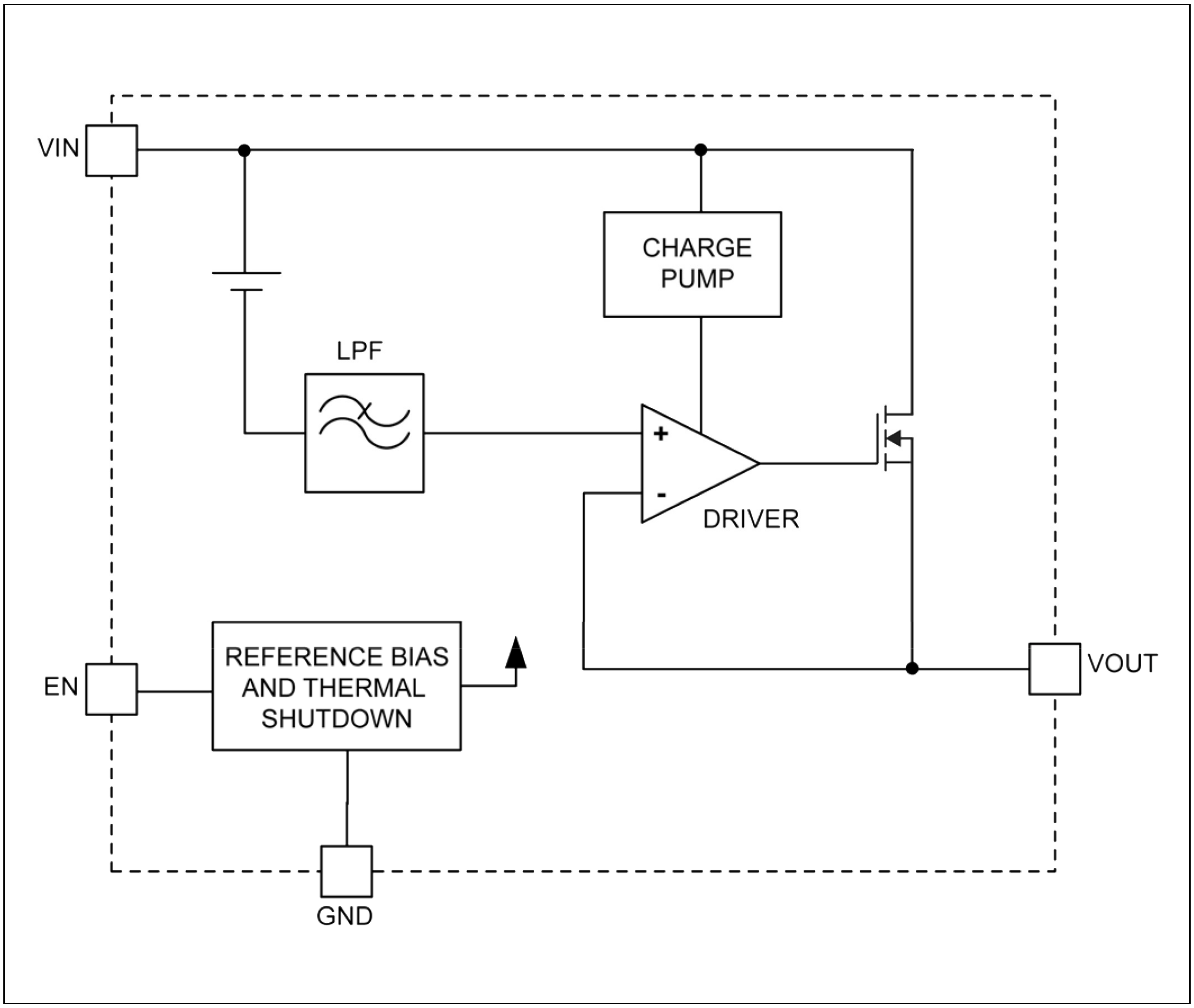
Typical Application Circuits

MIC94300





Functional Block Diagram



1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings †

Supply Voltage (V_{IN})......–0.3V to +4.0V
Output Voltage (V_{OUT})......–0.3V to +4.0V
Enable Voltage (V_{EN})......–0.3V to V_{IN} + –0.3V or +4.0V
ESD Rating (Note 1)......3 kV

Operating Ratings ‡

Input Voltage (V_{IN})......+1.8V to +3.6V
Enable Voltage (V_{EN})......0V to V_{IN}

† 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.

Note 1: Devices are ESD sensitive. Handling precautions recommended. Human body model: 1.5 kΩ in series with 100 pF.

ELECTRICAL CHARACTERISTICS

V_{IN} = V_{EN} = 3.6V; I_{OUT} = 100 µA; C_{OUT} = 1 µF; T_A = 25°C, **bold** values indicate –40°C ≤ T_J ≤ +125°C, unless noted.

Parameters	Sym.	Min.	Typ.	Max.	Units	Conditions
Input Voltage	V_{IN}	**1.8**		**3.6**	V	—
Voltage Drop	V_{DROP}	—	170	**250**	mV	V_{IN} – V_{OUT}, –40°C ≤ TJ ≤ +85°C
V_{IN} Ripple Rejection	PSRR	—	45	—	dB	f = 20 kHz, I_{OUT} = 100 mA
		—	60	—		f = 10 Hz to 100 kHz
Total Output Noise	e_{NO}	—	98	—	μV_{RMS}	V_{OUT} = 0V
Current Limit	I_{LIMIT}	**200**	315	400	mA	EN controlled
Turn-On Time	t_{ON}	—	40	150	µs	100 µA to 100 mA
Load Regulation	ΔV_{LDR}	—	10	—	mV	I_{OUT} = 100 µA
Ground Current	I_{GND}	—	138	200	µA	V_{EN} = 0V
Shutdown Current	I_{SD}	—	0.2	—	µA	—
Enable						
Input Logic Low	V_{EN_LOW}	—	—	**0.4**	V	—
Input Logic High	V_{EN_HIGH}	**1.0**	—	—	V	—
Input Current	I_{IN}	—	0.01	1	µA	—

Note 1: Specification for packaged product only.

TEMPERATURE SPECIFICATIONS

Parameters	Sym.	Min.	Typ.	Max.	Units	Conditions
Operating Junction Temperature Range	T_J	–40	—	+125	°C	—
Storage Temperature Range	T_s	–65	—	+150	°C	—
Lead Temperature	—	—	+260	—	°C	Soldering, 10 seconds
Thermal Resistance						
1.2 mm x 1.2 mm UDFN	θ_{JA}	—	173	—	°C/W	—

2.0 TYPICAL PERFORMANCE CURVES

Note:	The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only. The performance characteristics listed herein are not tested or guaranteed. In some graphs or tables, the data presented may be outside the specified operating range (e.g., outside specified power supply range) and therefore outside the warranted range.

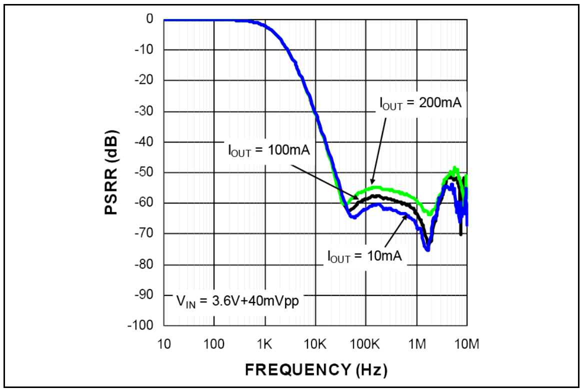


FIGURE 2-1: *PSRR C_{OUT} = 0.47 µF vs. Frequency.*

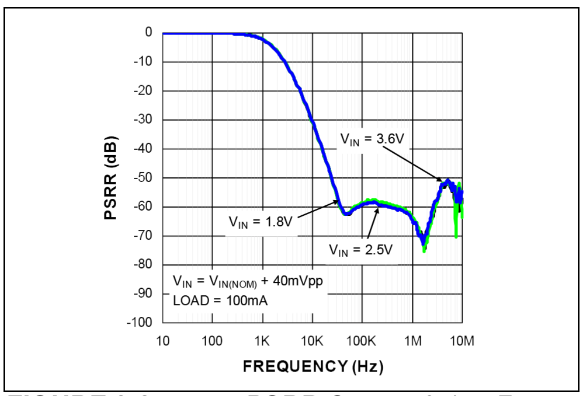


FIGURE 2-2: *PSRR C_{OUT} = 0.47 µF vs. Frequency.*

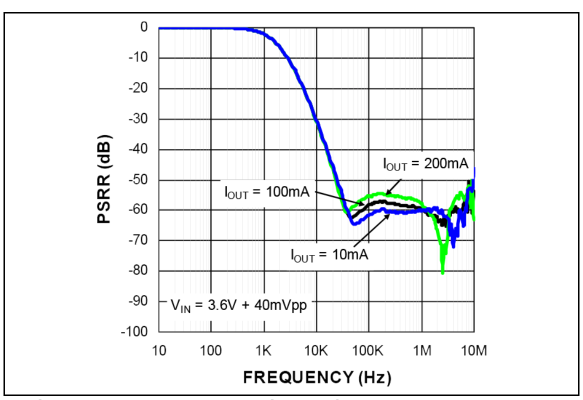


FIGURE 2-3: *PSRR C_{OUT} = 1 µF vs. Frequency.*

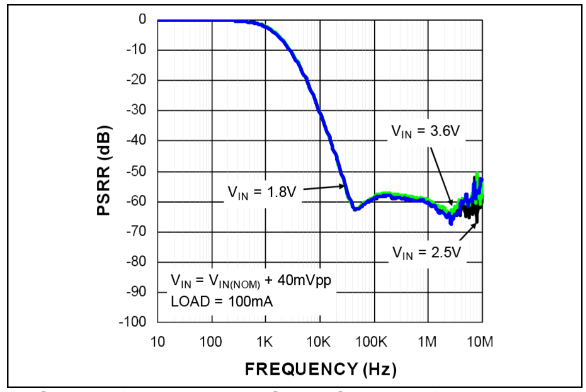


FIGURE 2-4: *PSRR C_{OUT} = 1 µF vs. Frequency.*

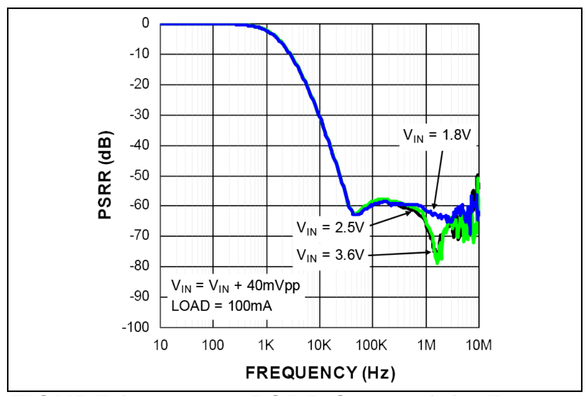


FIGURE 2-5: *PSRR C_{OUT} = 2.2 µF vs. Frequency.*

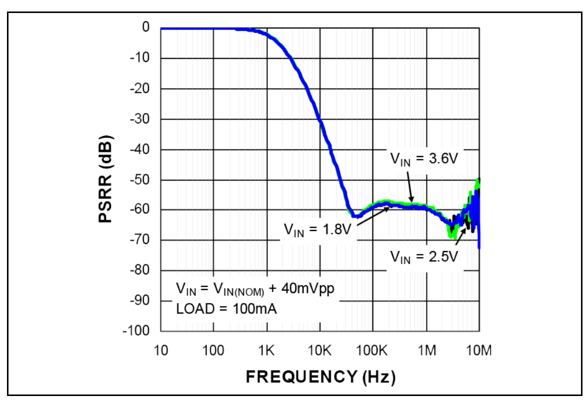


FIGURE 2-6: *PSRR C_{OUT} = 2.2 µF vs. Frequency.*

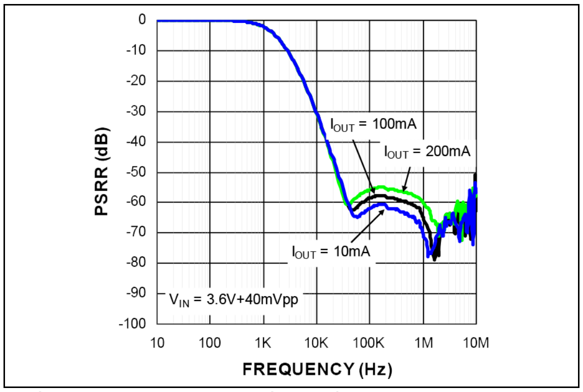


FIGURE 2-7: *PSRR C_{OUT} = 4.7 µF vs. Frequency.*

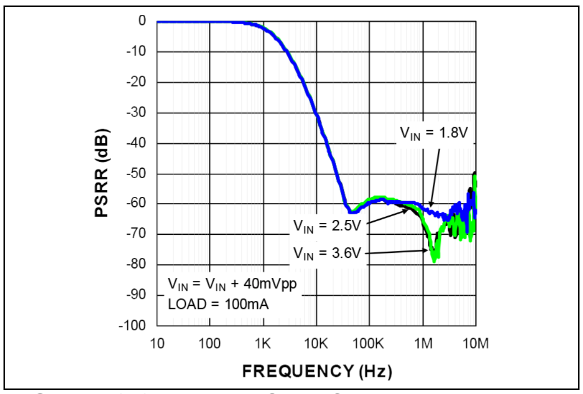


FIGURE 2-8: *PSRR C_{OUT} = 4.7 µF vs. Frequency.*

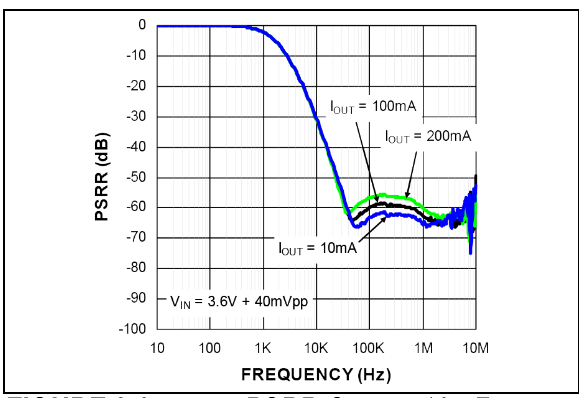


FIGURE 2-9: *PSRR C_{OUT} = 10 µF vs. Frequency.*

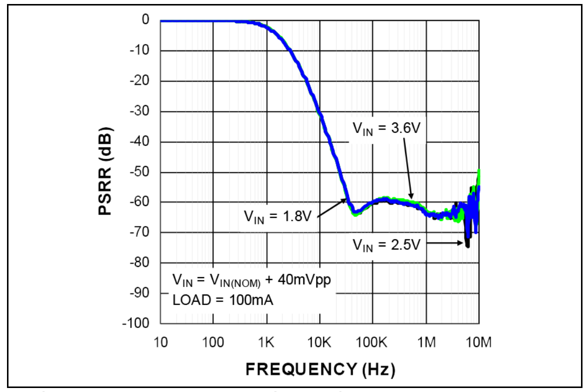


FIGURE 2-10: *PSRR C_{OUT} = 10 µF vs. Frequency.*

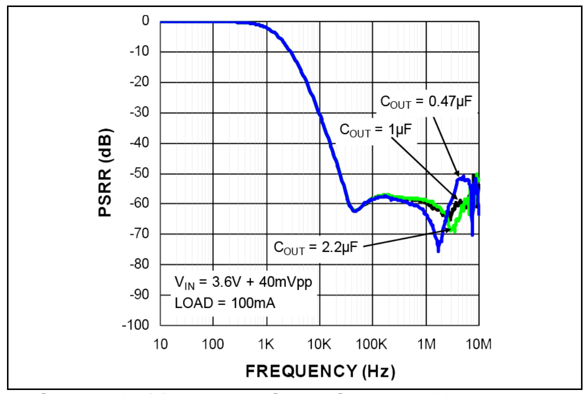


FIGURE 2-11: *PSRR C_{OUT} = 10 µF vs. Frequency.*

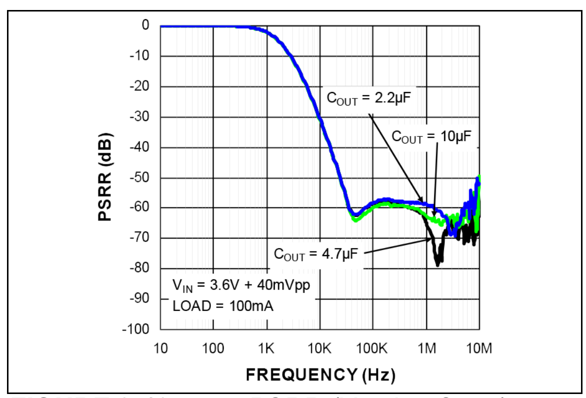


FIGURE 2-12: *PSRR (Varying C_{OUT}) vs. Frequency.*

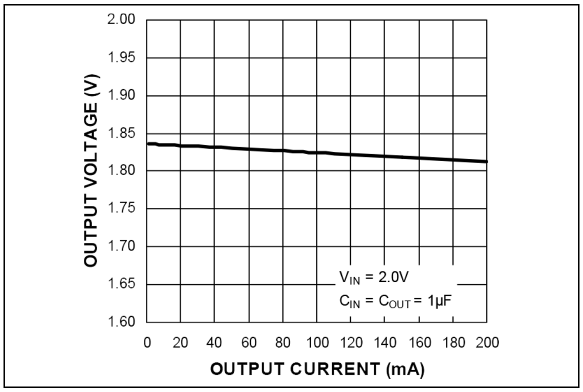


FIGURE 2-13: *Output Voltage vs. Output Current.*

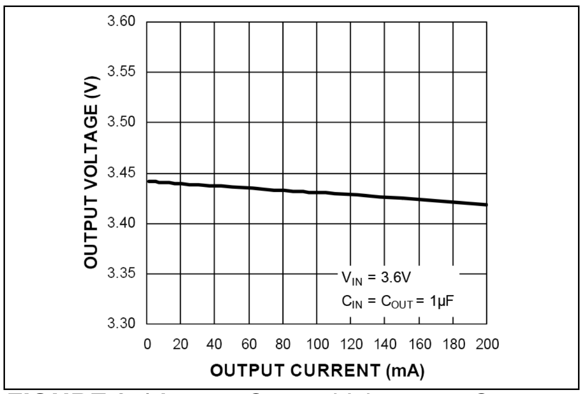


FIGURE 2-14: *Output Voltage vs. Output Current.*

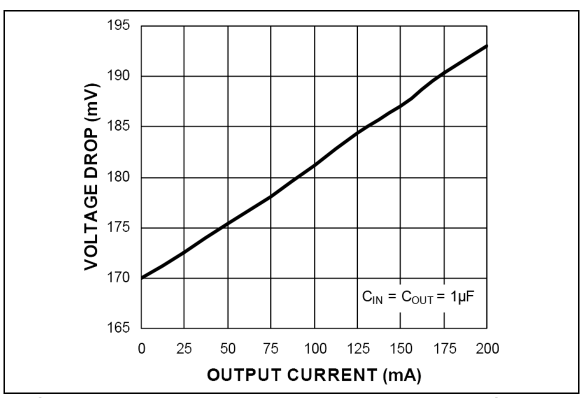


FIGURE 2-15: *Dropout Voltage vs. Output Current.*

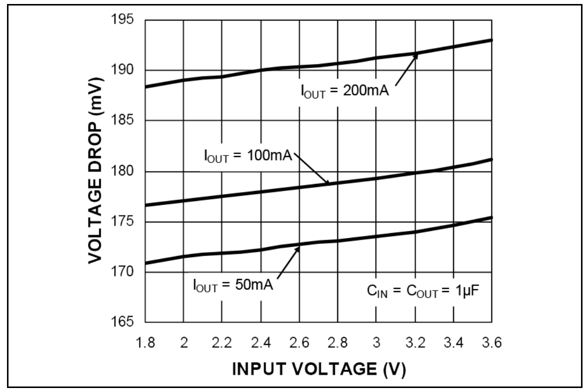


FIGURE 2-16: *Voltage Drop vs. Input Voltage.*

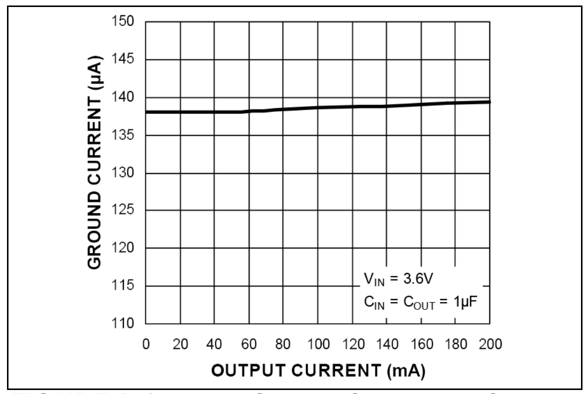


FIGURE 2-17: *Ground Current vs. Output Current.*

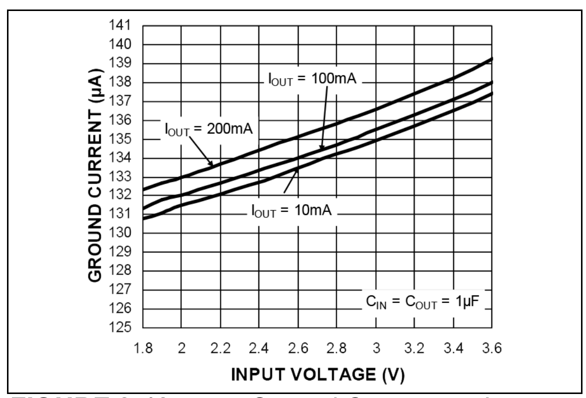


FIGURE 2-18: *Ground Current vs. Input Voltage.*

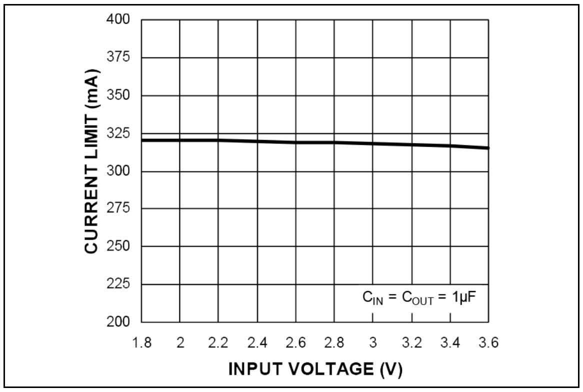


FIGURE 2-19: *Current Limit vs. Input Voltage.*

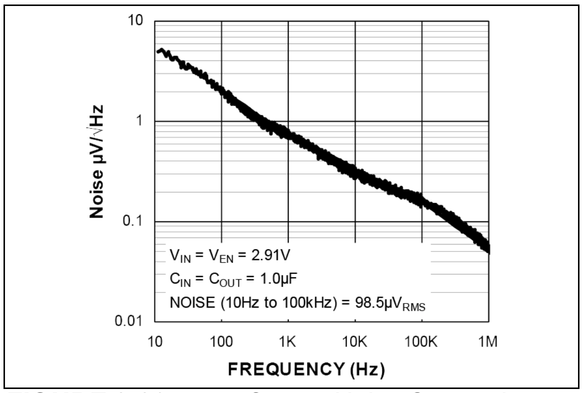


FIGURE 2-20: *Output Noise Spectral Density.*

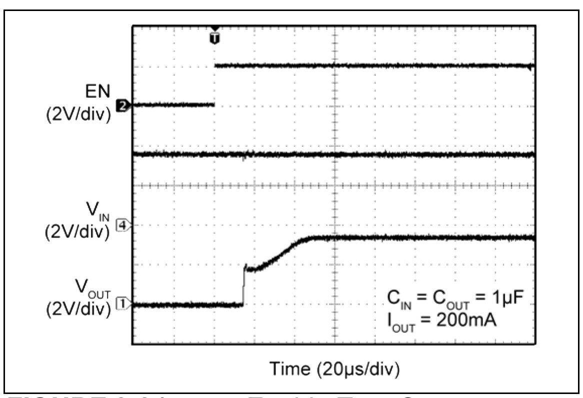


FIGURE 2-21: *Enable Turn-On.*

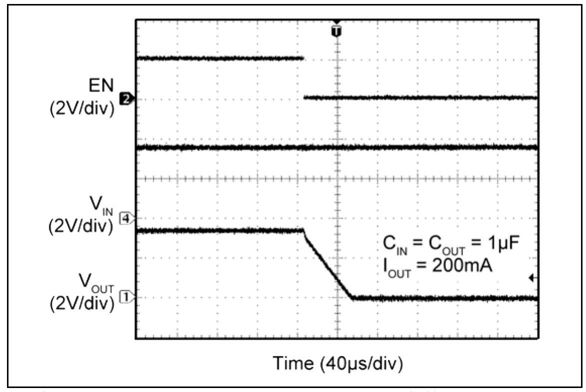


FIGURE 2-22: *Enable Turn-Off.*

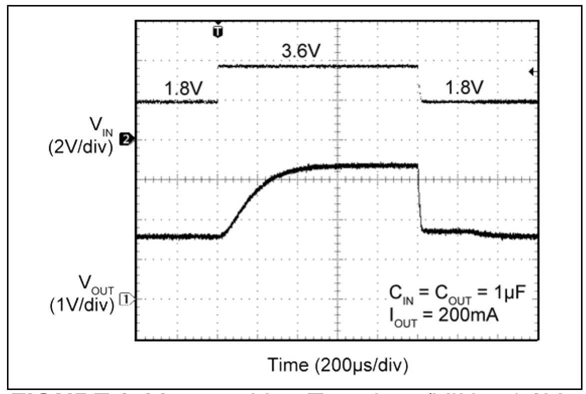


FIGURE 2-23: *Line Transient (VIN = 1.8V to 3.6V).*

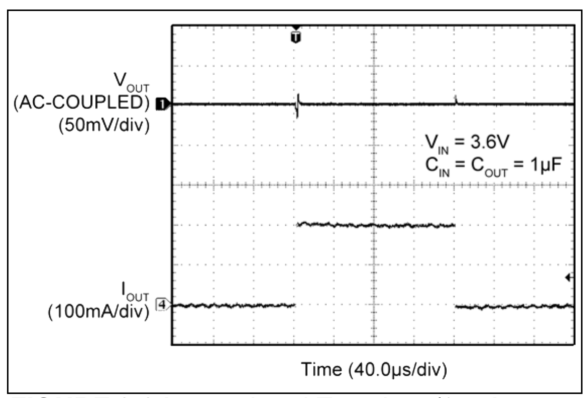


FIGURE 2-24: *Load Transient (0 mA to 200 mA).*

3.0 PIN DESCRIPTIONS

The descriptions of the pins are listed in Table 3-1.

TABLE 3-1: PIN FUNCTION TABLE

Pin Number (UDFN)	Pin Name	Description
1	EN	Enable input. A logic HIGH signal on this pin enables the part. Logic LOW disables the output. Do not leave floating.
2	GND	Ground.
3	VOUT	Power switch output.
4	VIN	Power switch input and chip supply.
EP	ePad	Exposed Heatsink Pad. Connect to Ground for best thermal performance.

4.0 APPLICATION INFORMATION

The MIC94300 utilizes Ripple Blocker™ technology to integrate a load switch with a high-performance active filter. The MIC94300 includes a low-voltage logic enable pin, and is fully protected from damage due to fault conditions, offering linear current limiting and thermal shutdown.

4.1 Input Capacitor

The MIC94300 is a high-performance, high-bandwidth device. An input capacitor of 470 nF is required from the input to ground to provide stability. Low-ESR ceramic capacitors provide optimal performance at a minimum of space. Additional high-frequency capacitors, such as small-valued NPO dielectric-type capacitors, help filter out high-frequency noise and are good practice in any RF-based circuit. X5R or X7R dielectrics are recommended for the input capacitor. Y5V dielectrics lose most of their capacitance over temperature and are therefore, not recommended.

4.2 Output Capacitor

The MIC94300 requires an output capacitor of 0.47 µF or greater to maintain stability. For optimal ripple rejection performance a 1 µF capacitor is recommended. The design is optimized for use with low-ESR ceramic-chip capacitors. High-ESR capacitors are not recommended because they may cause high-frequency oscillation. The output capacitor can be increased, but performance has been optimized for a 1 µF ceramic output capacitor and does not improve significantly with larger capacitance.

X7R/X5R dielectric type ceramic capacitors are recommended because of their temperature performance. X7R type capacitors change capacitance by 15% over their operating temperature range and are the most stable type of ceramic capacitors. Z5U and Y5V dielectric capacitors change value by as much as 50% and 60%, respectively, over their operating temperature ranges. To use a ceramic-chip capacitor with Y5V dielectric, the value must be much higher than an X7R ceramic capacitor to ensure the same minimum capacitance over the equivalent operating temperature range.

4.3 No Load Stability

The MIC94300 will remain stable with no load. This is especially important in CMOS RAM keep-alive applications.

4.4 Enable/Shutdown

The MIC94300 comes with an active-high enable pin that allows the Ripple Blocker™ to be disabled. Forcing the enable pin low disables the MIC94300 and sends it into a “zero” off mode current state. In this state, current consumed by the MIC94300 goes nearly to zero. Forcing the enable pin high enables the output voltage. The active-high enable pin uses CMOS technology and the enable pin cannot be left floating; a floating enable pin may cause an indeterminate state on the output.

4.5 Thermal Considerations

The MIC94300 is designed to provide 200 mA of continuous current in a very-small package. Maximum ambient operating temperature can be calculated based on the output current and the voltage drop across the part which is fixed at 170 mV typical, 250 mV worst case. For example if the input voltage is 2.75V, the output voltage is 2.5V, and the output current equals 200 mA. The actual power dissipation of the Ripple

$$P_D = \langle V_{IN} - V_{OUT1} \rangle \times I_{OUT} + V_{IN} \times I_{GND}$$

Because this device is CMOS and the ground current is typically <100 µA over the load range, the power dissipation contributed by the ground current is <1% and can be ignored for this calculation:

$$P_D = \langle 2.75V - 2.5V \rangle \times 200\ mA$$
$$P_D = 0.05W$$

To determine the maximum ambient operating temperature of the package, use the junction-to-ambient thermal resistance of the device and the following basic equation:

$$P_{D(MAX)} = \left(\frac{T_{J(MAX)} - T_A}{\theta_{JA}}\right)$$

Where:

$T_{J(MAX)}$ = 125°C

θ_{JA} = 173°C/W (YMT package)

Substituting P_D for $P_{D(MAX)}$ and solving for the ambient operating temperature will give the maximum operating conditions for the regulator circuit.

The maximum power dissipation must not be exceeded for proper operation.

For example, when operating the MIC94300YMT at 2.75V input voltage and 200 mA load with a minimum footprint layout, the maximum ambient operating temperature (T_A) can be determined as follows:

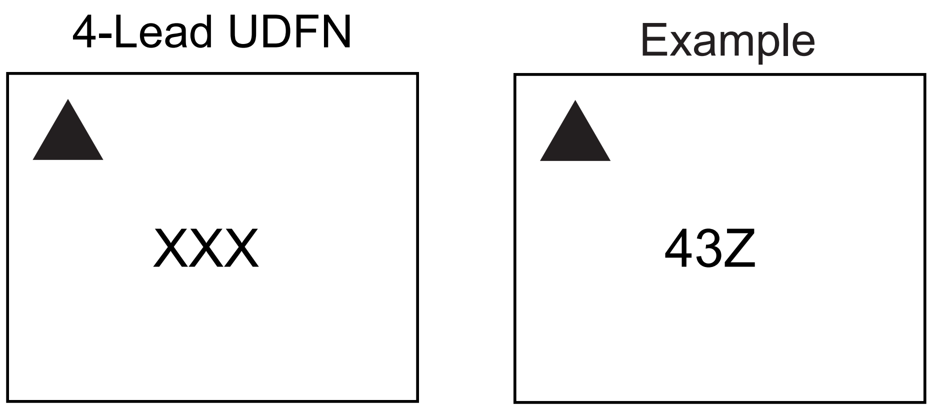
$$0.05W = \frac{125°C - T_A}{173°C/W}$$

$$T_A = 116°C$$

Therefore the maximum ambient operating temperature of 116°C is allowed. For a full discussion of heat sinking and thermal effects on voltage regulators, refer to the “Thermal Management” section of *Micrel’s Guide to Designing With Low-Dropout Voltage Regulators* handbook.

5.0 PACKAGING INFORMATION

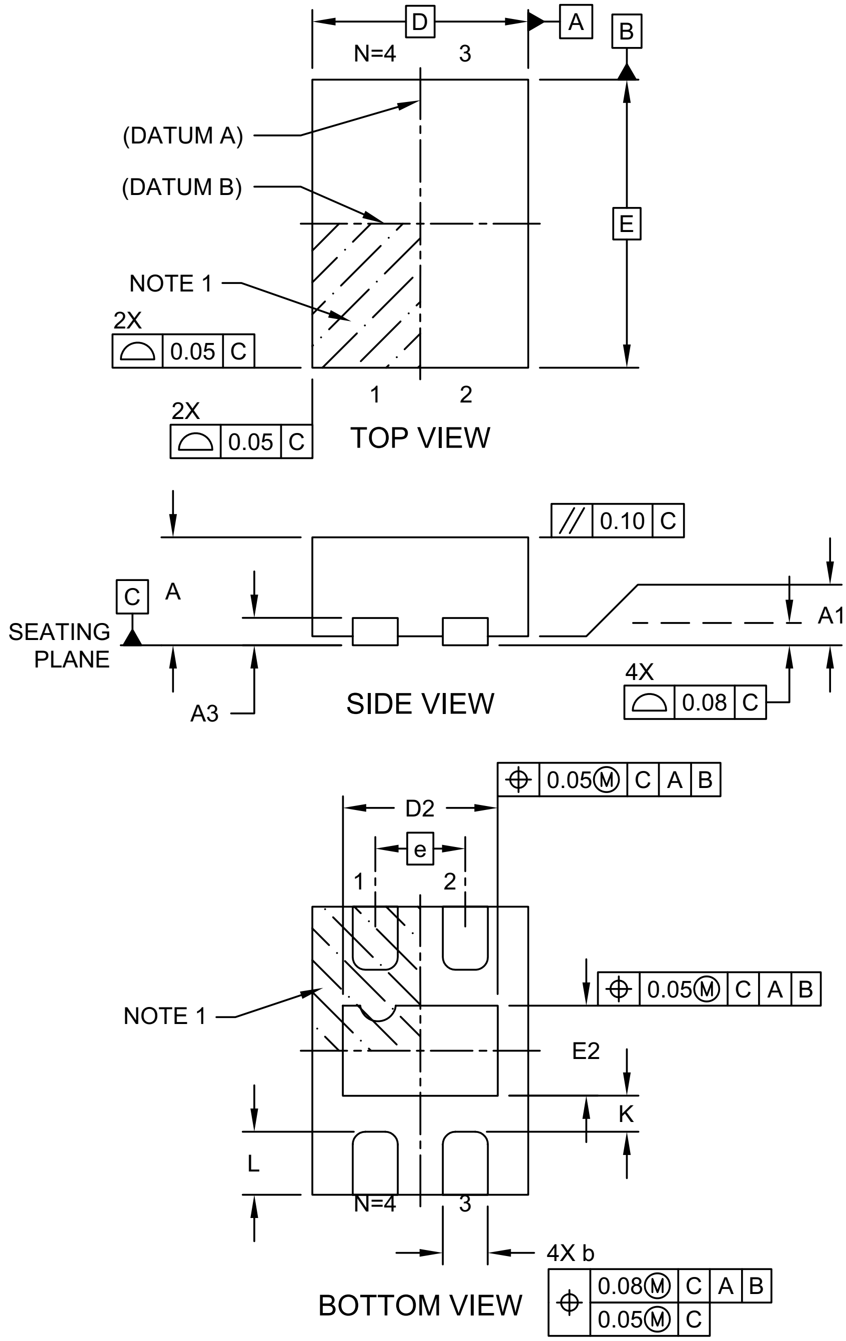
5.1 Package Marking Information



Legend	
Symbol	**Definition**
XX...X	Product code or customer specific information.
NNN	Alphanumeric traceability code.
e3	Pb-free JEDEC® designator for Matte Tin (Sn).
*	This package is Pb-free. The Pb-free JEDEC designator ( ) can be found on the outer packaging for this package.
●, ▲, ▼	Pin one index is identified by a dot, delta up, or delta down (triangle mark).
Additional Information	
Note 1	If the full date code (YYWW) and alphanumeric traceability code (NNN)—usually marked together on the last or only line of a package marking as the seven-character YYWWNNN—cannot fit on the package together, the codes will be truncated based on the number of available characters, as follows: 6 characters = YWWNNN; 5 Characters = WWNNN; 4 Characters = WNNN; 3 Characters = NNN; 2 Characters = NN; 1 Character = N.
Note 2	If the full Microchip part number cannot fit on one line, it will be carried over to the next line, limiting the number of available characters for customer-specific information. The package may or may not include the corporate logo.
Note 3	Some products might have a symbol "Y" at the end of the last (or only) line in a package marking to indicate the product is Pb-free.
Note 4	Any underbar (_) and/or overbar (‾) symbols shown in a package marking drawing may not be to scale.

4-Lead 1.2 mm × 1.6 mm UDFN [HGA] Package Outline and Recommended Land Pattern

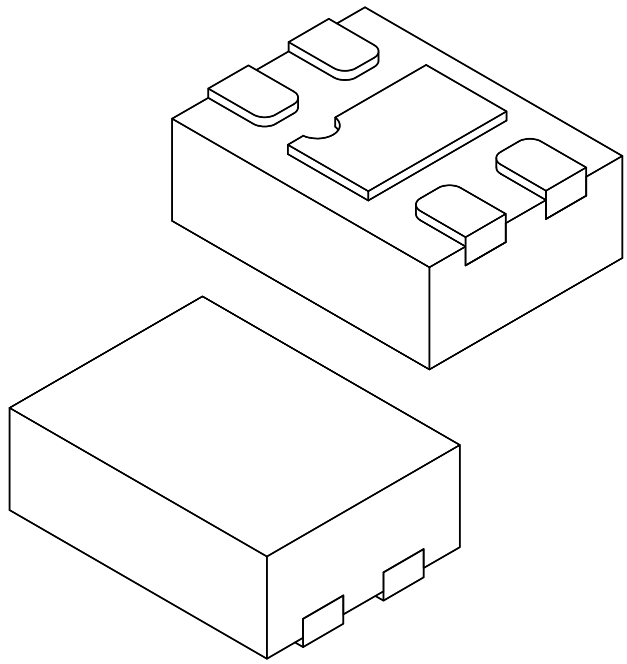
Note:	For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



Microchip Technology Drawing C04-1152 Rev A Sheet 1 of 2

4-Lead 1.2 mm × 1.6 mm UDFN [HGA] Package Outline and Recommended Land Pattern

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



	Units	MILLIMETERS		
	Dimension Limits	MIN	NOM	MAX
Number of Terminals	N		4	
Pitch	e		0.50 BSC	
Overall Height	A	0.50	0.55	0.60
Standoff	A1	0.00	0.02	0.05
Terminal Thickness	A3		0.152 REF	
Overall Length	D		1.20 BSC	
Exposed Pad Length	D2	0.81	0.86	0.91
Overall Width	E		1.60 BSC	
Exposed Pad Width	E2	0.45	0.50	0.55
Terminal Width	b	0.20	0.25	0.30
Terminal Length	L	0.30	0.35	0.40
Terminal-to-Exposed-Pad	K	0.20	–	–

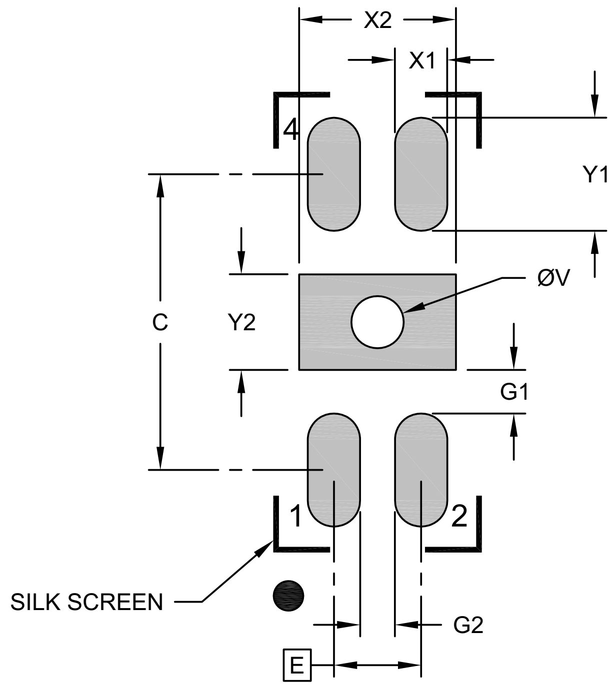
Notes:

1. Pin 1 visual index feature may vary, but must be located within the hatched area.
2. Package is saw singulated
3. Dimensioning and tolerancing per ASME Y14.5M
   BSC: Basic Dimension. Theoretically exact value shown without tolerances.
   REF: Reference Dimension, usually without tolerance, for information purposes only.

Microchip Technology Drawing C04-1152 Rev A Sheet 2 of 2

4-Lead 1.2 mm × 1.6 mm UDFN [HGA] Package Outline and Recommended Land Pattern

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



RECOMMENDED LAND PATTERN

Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Contact Pitch	E		0.50 BSC	
Optional Center Pad Width	X2			0.90
Optional Center Pad Length	Y2			0.55
Contact Pad Spacing	C		1.70	
Contact Pad Width (X4)	X1			0.30
Contact Pad Length (X4)	Y1			0.65
Contact Pad to Center Pad (X4)	G1	0.25		
Contact Pad to Contact Pad (X2)	G2	0.20		
Thermal Via Diameter	V		0.30	

Notes:

1. Dimensioning and tolerancing per ASME Y14.5M
   BSC: Basic Dimension. Theoretically exact value shown without tolerances.
2. For best soldering results, thermal vias, if used, should be filled or tented to avoid solder loss during reflow process

Microchip Technology Drawing C04-3152 Rev A

APPENDIX A: REVISION HISTORY

Revision A (May 2024)

- Converted Micrel document MIC94300 to Microchip data sheet DS20006844A.
- Content related to the Schematic Diagram, Bill of Materials, and PCB Layout removed as that can be found in the MIC94300 User’s Guide.
- Removed references to phased out package options.
- 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 Number	X	XX	-XX
Device	Junction Temp. Range	Package	Media Type

Device:	MIC94300:	200 mA Switch with Ripple Blocker™ Technology
Junction Temperature Range:	Y =	–40°C to +125°C
Package:	MT =	4-Lead UDFN
Media Type:	TR =	5000/Reel

Examples:

a) MIC94300YMT-TR: MIC94300, –40°C to +125°C Temperature Range, 4-Lead UDFN, 5000/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 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.

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 https://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.

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

Trademarks

The Microchip name and logo, the Microchip logo, Adaptec, AVR, AVR logo, AVR Freaks, BesTime, BitCloud, CryptoMemory, CryptoRF, dsPIC, flexPWR, HELDO, IGLOO, JukeBlox, KeeLoq, Kleer, 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, ClockWorks, The Embedded Control Solutions Company, EtherSynch, Flashtec, Hyper Speed Control, HyperLight Load, Libero, motorBench, mTouch, Powermite 3, Precision Edge, ProASIC, ProASIC Plus, ProASIC Plus logo, Quiet-Wire, SmartFusion, SyncWorld, TimeCesium, TimeHub, TimePictra, TimeProvider, 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, Clockstudio, CodeGuard, CryptoAuthentication, CryptoAutomotive, CryptoCompanion, CryptoController, dsPICDEM, dsPICDEM.net, Dynamic Average Matching, DAM, ECAN, Espresso T1S, EtherGREEN, EyeOpen, GridTime, IdealBridge, IGaT, In-Circuit Serial Programming, ICSP, INICnet, Intelligent Paralleling, IntelliMOS, Inter-Chip Connectivity, JitterBlocker, Knob-on-Display, MarginLink, maxCrypto, maxView, memBrain, Mindi, MiWi, MPASM, MPF, MPLAB Certified logo, MPLIB, MPLINK, mSiC, MultiTRAK, NetDetach, Omniscient Code Generation, PICDEM, PICDEM.net, PICkit, PICtail, Power MOS IV, Power MOS 7, PowerSmart, PureSilicon, QMatrix, REAL ICE, Ripple Blocker, RTAX, RTG4, SAM-ICE, Serial Quad I/O, simpleMAP, SimpliPHY, SmartBuffer, SmartHLS, SMART-I.S., storClad, SQI, SuperSwitcher, SuperSwitcher II, Switchtec, SynchroPHY, Total Endurance, Trusted Time, TSHARC, Turing, 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, and Symmcom 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.

ISBN: 978-1-6683-4551-1

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: 45-4485-5910
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 - Hod Hasharon
Tel: 972-9-775-5100

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